

LAKE MICHIGAN POTENTIAL DAMAGES STUDY

For the U.S. Army Corps of Engineers

Planning & Zoning Center, Inc. and Wade-Trim

TASK 8.1 UPDATE CURRENT LAND USE MANAGEMENT PRACTICE INVENTORY

Under Phase 2 of the IJC Levels Reference Study, the USACE contracted for a comprehensive inventory of current land use management practices in the United States shorelines of the Great Lakes. The Contractor will review this prior work and modify it accordingly for current conditions employed in Michigan, Wisconsin, Illinois and Indiana. Further, evaluate whether other land use management measures currently exist in the five prototype counties that should be included under this inventory. Generate a summary report for this investigation.

1.0 INTRODUCTION

1.1 Overview

The land use of the Great Lakes shorelines has changed with a growing economy and increase in population. Following initial European settlement, the land uses were primarily related to the shipping of natural resources (furs, timber, minerals and fish). Eventually, industrial and agricultural uses predominated, the latter flourishing where soils were suitable. The recreational use that occupied a very small portion of the shoreline as destination resorts in the early years of settlement, has expanded and shifted, especially in recent years, to permanent and seasonal residences as the predominate land use outside of established cities and villages. There is still a significant amount of agricultural and forested land, but it is rapidly being converted to residential use along Lake Michigan.

Investigation of land use change and management responses along the shoreline is important because:

- Shorelines are important but fragile natural, economic and quality of life resources for the citizens of Great Lake states.
- How land is used along the shoreline affects the quality of both land and water resources and its availability to the population.
- Natural processes pose significant hazards to health and safety, especially flooding, shoreline erosion and navigation.
- Land use management can be an effective tool in limiting shoreline damages from changing lake levels and minimizing threats to public health and safety. Shoreline change is due to both natural forces and human use, but human use is the only factor that can be effectively managed. Lake level change can theoretically be regulated, but at best it only slows bluff erosion since bluff slumping is a continuing process, not entirely affected by lake levels. Further,

regulated, or controlled lake levels lead to a concentration of erosion at one elevation. Estuarine areas can suffer flooding damage as a result of either (or both) high Great Lakes levels and stormwater and snowmelt from inland areas.

- Land use decisions made over the past fifty years, are probably most responsible for past, present and future potential damages due to shoreline flooding and erosion. Shoreline land use management decisions are made through a multi-layered web of private and public entities (local, state and federal jurisdictions) without the benefit of a set of coordinated goals, principles and policies on shoreline issues. The result is present and likely much higher future potential damages than if all decision makers worked toward achievement of a common set of goals and pursuant to an agreed to a set of shoreline development principles and policies.

1.2 Objective and Organization of Report

The objective of this report is to discuss changes between 1993 and 1999 in shoreline management along Lake Michigan and include land use management issues not addressed in the 1993 IJC Levels Reference Study. It is believed the information in this report should be considered in the discussion of future shoreline management options to reduce potential damages.

The format of this report is as follows:

- The numeric “outline” structure of the 1993 Report is followed.
- This report suggests modifications to various sections of the 1993 IJC Report as needed and adds sections where appropriate, using the numbering system of the 1993 IJC Report. The new discussion of land use management tools is added to existing sections where most pertinent.
- Text from the 1993 IJC Report is not repeated here unless necessary to make a point.
- This report accepts those land use activities described in the 1993 IJC Report as “shoreline management” as land use management activities in this 1999 update.

1.3 Definitions

The 1993 IJC Report provided an excellent set of definitions that are accepted for use in this 1999 Report. [NOTE: The following text in *italics* is reproduced from the 1993 IJC Report.]

1.3.1 The 1993 IJC Report defined “shoreline management” as:

"The approach taken or the actions adopted in order to direct activities along the shoreline in a fashion that will reduce the adverse consequences between human activity and the physical characteristics that exist. These consequences are generally viewed as primary (e.g. loss of land, structures, etc.) or secondary

(e.g. impacts on shipping and subsequent impacts on industry relying on shipping). The approach to shoreline management is wide ranging. It can include control of human activities to reduce conflict (e.g. relocate buildings, regulate uses), provide financial incentives to encourage changes to human activity and to reduce conflict (e.g. loans, tax incentives), and direct manipulation of the shoreline form of process which lead to impact (e.g. structural and non-structural protection)." (Triton Engineering Services Limited and Ecologistics Limited)

In the context of this report, "land use management" is a subset of "shoreline management" that focuses only on land use.

Definitions

Definitions of shoreline management and shoreline management practices and the way in which they are perceived tend to vary among individuals and groups. The following definitions are offered to provide a clear conceptualization of the measures evaluated and to guide interpretation and application of the results and recommendations contained in this report.

1.3.2 Shoreline Management Measures and Implementation Mechanisms

For the purposes of this report, shoreline management alternatives have been categorized as either shoreline management measures or as implementation mechanisms.

Shoreline management measures are specific actions undertaken affecting the shoreline or riparian property owners that either limit or eliminate the potential for damage to shoreline property. Shoreline management implementation mechanisms are incentive based methods to either encourage or discourage the use of shoreline management measures or other activities and uses along the shoreline.

In order to provide for consistency in the reporting, evaluating and comparing of results across of the Task Groups of the other Committees, the definitions listed below are taken from the following documents:

- 1. Procedure; for Conducting Impact Assessments. Levels Reference Study Phase 11 Guiding Document. December 1991.*
- 2. Living With the Lakes: Challenges and Opportunities - Annex E: Potential actions to Deal with the Adverse Consequences of Fluctuating Water Levels. Measures Workshop Group Report, IJC Water Levels Reference Study, May, 1989.*

The following explicit definitions of individual measures and implementation mechanisms are based in whole from the descriptions contained in the above-noted documents.

1.3.3 Shoreline Management Measures

1.3.3.1 Setbacks

Setbacks consist of regulations requiring that new development along the shoreline take place landward of a predetermined flood or erosion line. Potentially, construction would be allowed lakeward of the setback limit if authorized by the implementing authority as long as the buildings or other uses are portable, temporary or could be moved prior to damage.

1.3.3.2 Relocation of Dwellings

Relocation of dwellings involves the movement and subsequent relocation of dwellings out of flood and erosion hazard zones. Relocation can either be permanent or temporary. For example, some buildings, depending on local conditions, could be designed or adapted to be moved from harms way only when the need (i.e. crisis conditions) arose. Conversely, permanent relocation would occur in the one-time movement of buildings to new foundations located beyond the hazard area.

1.3.3.3 Flood Elevation Requirements

Flood elevation requirements could ensure that any new construction, or any existing structures in a hazard area would be raised above a predefined level (i.e. the 100 year flood line). The measure would include allowing construction in the hazard zone but would ensure that new development, or existing development (through retrofitting), lakeward of the 100 [year] flood line [floodplain] be floodproofed.

1.3.3.4 Land Acquisition

Land acquisition consists of communities or agencies purchasing property located in the hazard zone as a means of preventing future damages and losses to property. Once purchased, the property would be under direct ownership of the community or agency who would have complete control over its land use and development. The community could decide, for example, to convert the newly acquired property to parkland for recreational purposes or alternatively, provide for limited use or development of the property in a manner that could significantly reduce or eliminate future potential damages.

1.3.3.5 Structural Shore Protection to Prevent Flooding

This group of measures would include the use of dikes and levees as both permanent and temporary measures to form a protective barrier in front of flood-prone land. The primary purpose of these structures is to prevent floodwater from

inundating the land. These measures may also assist in erosion damage protection.

1.3.3.6 Structural Protection to Prevent Erosion

There are a number of structural measures to assist in protecting the shoreline from erosion damage. These measures include the use or construction of revetments; seawalls; break-waters; offshore barrier islands; groins; jetties and artificial headlands.

Revetments are comprised of a heavy facing (armor) that is placed on a slope to protect it and the adjacent upland from wave action and scour. Revetments are supported from beneath by the soil on which they are constructed and are built on an angle such that the wave energy is dissipated over them. Revetments may be either rigid or flexible.

Seawalls are vertical structures constructed to separate land and water areas thus providing protection to property on the landward side from erosion and wave action.

Breakwaters, as shore protection devices, are placed out in the water to intercept wave energy approaching the shore. These structures form a low-energy shadow zone on their leeward side and have the effect of trapping and accumulating longshore transported sediment.

Artificial barrier islands perform a similar function to breakwaters except that they are larger and can provide an added benefit of supporting recreational activities. [However, according to the Michigan Department of Environmental Quality, these are not realistic for use in Lake Michigan.]

Groins and jetties are structures constructed perpendicular to the shore extending out into the water. Used singly or in groups, called "groin fields", these structures trap sand or retard its longshore movement along beaches. Sand accumulates in fillets on the updrift side of the structure and the shoreline rotates to align itself with the crest of the incoming waves.

Artificial headlands are a form of offshore breakwater and are constructed to be aligned with the predominant direction of wave approach. This configuration allows the beach to erode to a stable configuration that is commonly found in natural headland-bay situations.

1.3.3.7 Non-Structural Shore Protection

Non-structural shore protection methods, as defined by the Levels Reference Study Board, consist primarily of beach nourishment and also the use of vegetated buffers. Beach nourishment involves the placing of sand on a

shoreline by mechanical means (e.g. dump truck or dredging and pumping). The stabilization of areas with vegetation involves the planting and establishment of stabilizing vegetation on bluffs, dunes and shorelines to prevent erosion.

1.3.3.8 Shoreline Alteration Requirements

These requirements essentially consist of regulating public and private construction of shore protection and navigation structures, including the alteration of the nearshore zone either by fill extraction or deposition. The regulatory process ensures that proper technical advice and permits are in place before any alterations to the shoreline are permitted.

1.3.3.9 Habitat Regulations

Measures included in this category include regulations to protect sensitive coastal and riparian habitat located on private and public land. Many habitat areas under the jurisdiction of state and federal governments (e.g. parks) are already well protected, however private land may also be regulated through legislation and policy.

1.3.3.10 Development Controls for Public Infrastructure

These measures would include the requirements for public agencies and ministries to provide for: a) the location of public infrastructure outside of hazard areas and/or b) to ensure that facilities located within hazard areas are done so only out of necessity and ensures that they are adequately located and protected to prevent substantial damage from extreme conditions.

1.3.4 Implementation Mechanisms

1.3.4.1 Loans

Loans are mechanisms to encourage shoreline property owners to undertake certain actions for shore protection or hazard/damage reduction. Loans may either be guaranteed or subsidized. The incentive of reduced interest rates, or guaranteed repayment to the lender may make certain shoreline management options more attractive and feasible to riparian property owners. Loans could be used, for example, to implement the following shoreline management measures: relocation of existing structures, floodproofing of dwellings; drainage and pumping systems, vegetation planting, etc.

1.3.4.2 Grants

Grants are another method of providing incentives to undertake the types of shoreline management measures outlined under loans. The difference, however, is that grants are an outright transfer of money from one level of government to

another or to private landowners. There is no requirement to repay the transferred monies to the granting agency.

1.3.4.3 Insurance

This mechanism uses insurance to encourage the proper use of property in the coastal zone. Examples include eliminating or reducing the availability of hazard insurance to shoreline property owners, or making insurance available on buildings that are adequately floodproofed, etc. This measure is primarily applicable in the United States [National Flood Insurance Program]. To date the utilization of property insurance as an incentive to encourage proper shoreline management is not typical in Canada.

1.3.4.4 Tax Incentives

Tax incentives apply to a variety of financial means of utilizing the tax institution to promote or discourage activities and uses along the shoreline. Tax advantages could be realized by property owners using preferred measures, while the tax burden could be increased for property owners engaging in non-preferred activities or uses.

2.0 METHODOLOGY

2.1 Overview

This 1999 update does not repeat the same methodology as the 1993 IJC Report. This study:

- Reviewed the 1993 IJC Report to identify topic areas to investigate.
- Identified additional topics important to shoreline management.
- Sought compiled data and anecdotal information on the topics being investigated.
- Fit updates and new information into the existing format of the 1993 IJC Report.

The scope of study of this 1999 Report is narrower than the 1993 IJC Report, which investigated shoreline management on both the Canada and United States sides of all the Great Lakes and the St. Lawrence River. This study focused on the states surrounding Lake Michigan, and five counties in particular: Allegan and Ottawa Counties in Michigan and Manitowoc, Ozaukee and Sheboygan Counties in Wisconsin. To a limited extent, information on state-level shoreline management was also investigated in Indiana and Illinois.

2.2 Screening of Measures

The screening employed in the 1993 IJC Report was not followed in 1999. The consultants found the 1993 screening to not be particularly revealing or detailed and there appeared to be no practical purpose to the grouping. Instead the discussion of each shoreline measure studied in 1999 includes comments on how useful and how frequently used a particular measure appears to be and why.

2.3 Evaluation Framework

2.3.1 Shoreline Management Objectives

This update to the 1993 IJC Report adds three objectives to the first two dealing with reduction of damages and loss to structures and property.

Objective 1: Reduce damages to structures and property from erosion, flooding and extreme high and low water impacts. (1993 IJC Study)

Objective 2: Reduce loss of shoreline property and structure use from erosion, flooding and extreme high and low water impacts. (1993 IJC Study)

Objective 3: Investigate or conjecture whether some shoreline management approaches can be effectively, efficiently and fairly established and implemented

by local units of government while others can best be established and/or administered at the state level. (New objective)

The new third objective acknowledges the important role of local land use management. Federal and state governments have limited funds, response capacity and local knowledge to deal with all hazard zone issues. Federal and state governments can provide education, technical assistance, emergency assistance and loans, grants or aid to help fund emergency responses that are beyond the reach of local communities. However, they are at a disadvantage in dealing with long-term, incremental, site specific decision making that hazard zone land management requires. Where local governments are willing to take on the responsibility, they have a distinct advantage in being able to educate and assist property owners at this level.

Objective 4: Investigate whether education and technical assistance to existing and prospective property owners and to supporting real estate and banking interests can greatly reduce unwise decisions on shoreline structure siting and shore protection investments. (New objective)

The fourth objective recognizes the significant role that well informed existing and prospective shoreline property owners and their supporting real estate and financial service providers can play in minimizing damage from shoreline erosion and flooding.

Objective 5: Speculate whether, over a period of time, the private sector could assume a principal responsibility and liability for ensuring the safe siting of structures in areas prone to flooding or erosion. (New objective)

The fifth objective recognizes the potential to shift responsibility and liability for shoreline siting decisions to the private sector without a loss of public health, safety and general welfare interests.

While these three new objectives present intriguing possibilities, little information contained in this report adequately supports or rejects the viability of achievement of these objectives. Instead, additional speculation and research is needed. However, the last chapter does attempt to present some conclusory thoughts and recommendations with regard to all five objectives. It is hoped additional research can examine the feasibility and desirability of achieving these three new objectives. They hold considerable promise to reduce potential damages from flooding and for shoreline erosion with little new government regulation or expenditure on new or revised government shoreline programs.

2.3.2 Problem Definition

There can be great economic costs as a result of natural shoreline processes such as flooding, bluff erosion and extremely low water. As indicated in 1993,

environmental, developmental and policy factors can interact to either raise or lower hazard-related costs. The very problem faced by the 1999 update is how effective are shoreline and land use management approaches in dealing with the potential economic losses from hazards. Are they effective in minimizing loss and protecting property and resources? Can they be adequately implemented by the agencies and jurisdictions involved? Are other tools and or approaches likely to produce better results?

2.3.3 Evaluation Criteria

In the broadest sense, the criteria of effectiveness and capacity to be implemented are used in the 1999 study as they were in the 1993 IJC Report.

2.3.4 Effectiveness

There appears to be no comprehensive, coordinated data base upon which to evaluate shoreline management effectiveness. This evaluation, of necessity, is highly qualitative. Evaluation of management effectiveness is based entirely upon professional judgement of those officials interviewed and the consultant professionals conducting the study. A measure is effective if it reduces damages and property loss and can be effectively administered by a local unit of government or state government. However, without a completed damage estimate to serve as a base line, there is no way to compare the resultant or likely savings or increased losses due to alternative shoreline management approaches.

2.3.5 Compatibility

As expressed in the 1993 IJC Report, this criteria was applied to issues outside of the stated shoreline management objectives. It should really be called "Indirect Effects," and is treated as such in this 1999 Report, dealing with environmental, fiscal, visual quality effects and others. The term, "Indirect Effects" has been added to the headings where "Compatibility" appears.

2.3.6 Implementability

The components of the implementability criteria used in the 1993 IJC Report were used in the 1999 study. Implementation depends on many factors: enabling legislation, political will, agency staffing levels and policy, complexity of the tool, technical understanding, degree of knowledge of those being regulated, perceived threat and others.

2.3.7 Present Value of Dollar Figures

Because a separate task to assess potential damages was being conducted in 1999 (Task 7), cost issues were not quantified in this 1999 update. There are

costs involved in implementing structural and non-structural shoreline protection measures but there are also costs to implement regulatory and land use planning measures. The latter can include consultant fees, staffing costs and can be partially offset by permit fees. Administrative costs vary widely at the local level depending on the size of the community and extent of the program undertaken. While the 1993 IJC Report provided extensive discussion of both structural/non-structural and administrative costs, this 1999 Report does not. Good data is not available.

2.3.8 Results of the Evaluation

The results of the 1999 study are largely qualitative, and are reported primarily in text discussion. A separate evaluative table is also included in Section 17.

2.4 Generic Evaluation and Assessment

The 1999 approach is similar to that of the 1993 IJC Report. Sources for evaluation included literature (See Bibliography), interviews with local and state officials and a series of focus groups for opinion background.

2.5 Site-Specific Evaluations

The study area was defined as the states surrounding Lake Michigan with a focus on five counties. Some targeting occurred, with more detailed information on local implementation approaches obtained for the five counties and more generic information for the four states. Comparisons are sometimes made with states outside the Lake Michigan basin, where other states have dealt with erosion and flooding issues.

2.6 Data Sources

2.6.1 Generic Assessment

In addition to a literature review (see Bibliography), a qualitative assessment was made of the following:

- Master plans and zoning ordinances of communities within the five study counties that had prepared those documents.
- State statutes and administrative rules
- Shoreline permit information from the RAMS data base (USACE)
- Shoreline protection inventory (Orca Technologies, 1999)
- Focus group results of riparians and officials (PZC, 1999)
- Shoreline land use maps (Wade-Trim, 1999)
- Shoreline planimetric maps of Allegan and Ottawa Counties, Michigan (Wade-Trim, 1999).

2.6.2 Detailed Site Studies

Quantitative data bases were not used to evaluate sites within the study areas.

2.7 Interstate Committee on Land Use and Shoreline Management

There was no formal committee of state representatives with interaction or direction on the 1999 study such as existed prior to the 1993 IJC Report. These and many other stakeholders were however, invited to participate in a two day-long briefings in 1999 (in Muskegon and Manitowoc) and a large multi-stakeholder technical committee (with many academics) provided guidance and oversight to the Army Corps of Engineers on all phases of the potential damages study.

3.0 SETBACKS/RELOCATION OF DWELLINGS AND CURRENT LAND USE MANAGEMENT PRACTICES IN UNITED STATES GREAT LAKES SHORELINES

3.1 Overview

The 1993 IJC Report separated the land use management component of shoreline management into: 3.0 Setbacks/Relocation of Dwellings, 4.0 Flood Elevations/Flood Proofing, 5.0 Land Acquisition, 10.0 Habitat regulations, 11.0 development Controls for Public Infrastructure and 15.0 Deed Restrictions/Disclosures. A more comprehensive view of land use management includes land use and natural and cultural resource inventories, master planning, and land use regulations, such as zoning. These latter topics are attached to Section 3.0, Setbacks.

The 1993 IJC Report presented setbacks as:

- Regulations specifying that new development and redevelopment occurs landward of a predetermined erosion or flood control line.
- A line that can be either fixed or floating.
- A line that is generally set based on the 100-year flood elevation or a 30 to 60 year erosion rate (100-year erosion limit in the 1993 IJC Report).

3.2 Extent of Application

State regulated setbacks occur in Michigan and Wisconsin of the four Lake Michigan states. The Wisconsin setback is fixed at 75' landward of the ordinary high water line and Michigan's is 30 times the annual recession rate as measured from the top of the bluff. Wisconsin counties have also established their own setbacks, based on bluff height and other factors, that are generally more restrictive. The Michigan setback is applied to only those shorelines where erosion is a problem, which is about 8% of the Great Lakes shore.

3.3 Effectiveness

The mandatory minimum shoreline setback in Wisconsin applies to all shorelines (not just along Lake Michigan) in the state. As such it provides a modicum of uniform protection along all water bodies. This aspect makes it unique and highly significant from the perspective of minimizing potential damages along entire shorelines. However, because the setback is measured from the ordinary high water line and not from a bluff, it can, if additional county restrictions were relaxed, result in structures being permitted in unsafe locations where the bluff is near or considerably landward of the minimum setback line. As noted above, Wisconsin counties have established more restrictive setbacks.

The county regulations adopted in the study area counties are as follows:

- Manitowoc as of 1992. Conditional fixed setback. Minimum setback of 75 feet from ordinary high water mark (OHWM) for all structures except piers, wharves, bridges, dams, boathouses, patios, walkways and stairways necessary to provide pedestrian access to the shoreline. Greater setback for "permanent principal structures" is required where the shoreline has been receding and/or where bluffs of ten feet or more in height which rise at a slope of 2.5:1 (horizontal:vertical) or steeper. The greater setback for Manitowoc County sites is determined for three conditions:
 - For bluffs, a stable slope angle setback of 2.5:1 (horizontal:vertical) shall be made from the OHWM at a minimum of two measurement points for every 100 feet of shoreline not less than 50 feet apart.
 - For receding shorelines without bluffs, a fixed recession rate setback determined by "multiplying the average annual long term recession rate, which is two feet (2') per year adjacent to Lake Michigan, by structural design life of 50 years for principal or conditional uses or a structural design life of 25 years for accessory uses" (section 9.05.5b).
 - For areas where both shoreline recession and bluffs occur, the stable slope angle setback is added to the fixed recession rate setback to "arrive at the required setback for permanent principal structures" (section 9.05.5c).
- Ozaukee County as of 1992. Fixed setback, stable slope. In the Lake Michigan bluff and ravine area, setbacks for buildings, structures, seepage pits and soil absorption fields are to be determined based on a slope ratio of 2.5:1 (horizontal distance:vertical distance), measured from the toe of the slope. A chart is provided so that the user can calculate the setback distance from the bluff edge, based on this 2.5:1 stable slope, having measured the present slope angle. The setback distance must be "calculated using the most severe angle of slope, as determined by the County Zoning Administrator" (section 7.055 of the shoreland ordinance). Structures, buildings, seepage pits and soil absorption fields in Ozaukee County are to be setback at least 75' from the edge of any bluff or ravine.
- Sheboygan County as of 1992. Conditional, fixed setback including the area approach. Setbacks are required for all structures, except piers, wharves, boat hoists, boathouses, patios, bridges, dams and walkways and stairways which are necessary to provide pedestrian access to the shoreline (section 72.17.2). From the City of Sheboygan south to the south county line, the minimum setback is 100' from the OHWM. From the City of Sheboygan north to the north county line, the minimum setback is 225' from the OHWM. The stated rationale for a 100' setback: "the setback from Lake Michigan shall be based upon the long-term recession rate of two (2) feet per year and a 50 year period as the useful life of a typical residence (section 72.17.1)." The stated rationale for the larger 225' setback: "In addition, on steep bluffs it shall also be necessary to determine an additional setback distance based upon a stable slope angle of 2.5 feet horizontal distance for every one (1) foot vertical distance." An illustrative example is given for a bluff 50 feet high: 2.5 x 50 feet

= 125 feet plus 100 feet setback for recession = 225 feet total setback distance. (Keillor, January 1998 as quoted by Lulloff, 1998)

The approach in Michigan is nearly opposite. State established setbacks based on detailed high risk erosion analysis over 30 or more years are used to create 30 year and 60 year setbacks for specific reaches of shoreline. However, there are long stretches of Lake Michigan shoreline where historic erosion rates have not been enough to warrant establishing a setback. As a result, unless local governments impose a minimum setback (and some have) there is none.

The effectiveness of the Michigan program would be easy to improve merely by adding the Wisconsin approach. In Michigan, add a minimum setback from the ordinary high water mark plus an adjustment for bluff situations. This approach blends the benefits of a site-specific analysis with those of a uniform minimum setback. Some local governments in both Wisconsin and Michigan have already taken similar blended measures to achieve the greater certainty and protection afforded by this hybrid approach. Wisconsin has recently engaged in an evaluation process but the results have not been made available.

While local governments in Michigan have the authority to administer high risk erosion regulations, few have done so. This appears to be largely due to the fact that it is easier to let the state take any "grief" or "complaints" arising from the deeper setback provisions imposed by high risk erosion regulations in contrast to local zoning regulations (since most shoreline owners want the house to be as close to the water as possible). In contrast, county governments in Wisconsin administer the minimum shoreline setback provisions instead of the state – perhaps because the standard is so modest, and because it is a statewide uniform standard. In Wisconsin only counties are required to adopt the 75' setback, so cities and villages along the Great Lakes coasts do not have the setbacks. A blended approach would probably work best with the state administering the specific high risk erosion area setbacks (if Michigan's good experience is any indicator). This is especially so in light of the paucity of local governments which have opted to administer the "sand dune protection" provisions of Michigan's shoreline laws. A more consistent administration of complex high erosion setback regulations is also likely to arise from consistent application by a few highly trained state employees, as is done in Michigan. However, the DEQ may not be excited to take on any greater responsibility in this arena without broad legislative and citizen support, since they already take most of the "grief" associated with current regulations.

3.4 Compatibility/Indirect Effects

While the 1993 IJC Report listed several indirect benefits from setbacks: (reduced beach erosion, lower flood losses, improved scenery and public access), there has been no effective measure of these benefits. Focus group participants report a general increase in development of shoreline areas, more

blight from shore protection devices and reduced access. State officials in Wisconsin and Michigan report that existing regulations are largely being properly applied and conformed with by property owners except in a few isolated areas.

3.5 Implementability

As the 1993 IJC Report indicated, setbacks can be administered locally and they have some public support. But there are complicating situations involving existing constricted development, changing perceptions of regulation and new owners.

Local communities do not want to be the “bad guys” when dealing with local property owners, so communities usually resist implementing deeper setbacks in erosion hazard and sensitive dune areas. While the DEQ doesn't want to be the “bad guys” either, they must administer existing regulations. State and local officials report many requests for variances and a few attempts to repeal setback legislation. However, it does not appear many variances are being granted and state legislators have not repealed or emasculated either the Wisconsin or the Michigan legislation. Michigan does lose some appeals and occasionally encounters enforcement problems because there are no criminal penalties for violations.

While a second riparian survey has not taken place since that referenced in the 1993 IJC Report, a series of focus groups conducted in 1999 found a fairly strong acceptance of the setback concept but a very high belief that administration of setback regulations is highly inconsistent. Property owners wanted setbacks to be uniformly applied. This is probably because the site specific setbacks in Michigan are often very different in the same general area of shoreline, and/or because different counties in Wisconsin have implemented deeper setbacks than the state-mandated 75'.

3.6 Resource Inventories

3.6.1 Overview

Inventories of existing conditions are vital to effective land use management. Inventories not only provide officials with information on the resources to manage; they can help educate constituents about the extent of the resources of their community. Gaps and new opportunities can only be identified once a comprehensive inventory is complete.

3.6.2 Land Use/Cover

A land use is the type of activity that takes place on developed or actively used land, such as residential, agricultural, industrial or other. Land cover refers to whether undeveloped land is vegetated or barren, and if vegetated, what type. Is

it pine forest, open range land, emergent wetland, lowland forest or some other land cover?

A land use inventory is important for a variety of reasons, including:

- The community can know where different land uses are and evaluate whether the amount or mix of land uses is appropriate.
- The community can consider if particular land uses are appropriate for certain areas, such as residential, commercial, industrial or recreational uses in areas prone to flooding or at high risk of erosion.
- The community can estimate the affects of typical land use practices on sensitive resources. If an area of forest is being considered for a use that would remove the forest and replace it with a lot of impervious cover, consideration will have to be made for an increase in stormwater runoff.
- Each land use or cover requires special consideration when planning for the future. For example, if an area has been industrial and is being considered for another use, such as a park or housing, remediation of contaminated soils may be necessary.

It is important to look at both existing land use/cover and how that has changed over time.

In Michigan, the primary source of land use/cover information is the Michigan Resource Inventory System, or MiRIS. Land use/cover is mapped for all of Michigan based on 1978 air photographs and totals by type by jurisdiction are also available in tabular form. Efforts to update the information for the entire state are underway. Some communities have performed their own updates based on more recent aerial photography. Allegan County in Michigan is an example, and has land use/cover based on 1996 air photographs. The US Army Corps of Engineers has funded an update of land use/cover for the Michigan shoreline (to an inland depth of 1,000 feet) for virtually the entire Lake Michigan shoreline as part of a Bluff Stability/Bluff Erosion Study. The Study was completed in cooperation with Wisconsin Sea Grant and the University of Wisconsin-Madison. This study was based on 1996 air photos. The land use/cover update of the entire Lake Michigan shoreline of Michigan will be completed in 2000.

Individual coastal counties in Wisconsin have land use/cover maps for the entire county. These are based on air photos of different dates and are at different scales. Most of the information comes from two sources: the Bay-Lake Regional Planning Commission or northeast coastal counties and the Southeastern Wisconsin Regional Planning Commission (SEWRPC). With the exception of the Bluff Stability/Bluff Erosion study information, Bay Lake-RPC has maps based on 1995 air photos. SEWRPC land use/cover maps are based on air photos taken every five years since 1970 (plus 1963) with preparation of the 1995 maps in progress. In Brown County, land use/cover is based on 1"=200' air photos from 1990 for the whole county and 1994 for Green Bay.

Wisconsin also has a unique land cover map for the entire state, called WISCLAND dataset. It is the Rural Land Cover Vegetation Map, based on satellite imagery taken primarily in 1992.

Indiana

Land use/land cover are mapped in GIS at Indiana Dunes National Lakeshore. The land use inventory was from 1983 and was adapted from satellite images.

Illinois

Land use/land cover are mapped in GIS at the Northeastern Illinois Planning Commission. The land use map was adapted from 1990 satellite images. The land use map breaks down land uses into 45 categories. The map is presently being updated with 1995 satellite images.

3.6.3 Soils

Modern soils maps have been prepared for many counties in the Great Lakes states by the Natural Resource Conservation Service (formerly the Soil Conservation Service).

Soils maps provide clues to the erosion potential of floodplains and bluffs. They also provide information on the suitability for septic systems and building foundations. These maps can also provide insight into the location of wetlands that have been drained. Wetlands provide stormwater storage. They also are poor building locations as they may be poorly suited for foundations and can flood if field drains are broken, even if local creeks and rivers do not flood.

In a few cases, this information has been digitized for use in a GIS system. Unfortunately, modern soil surveys have not been completed for all shoreline counties. There are completed soil surveys for all shoreline counties in Wisconsin, as well as in the Michigan pilot counties of Ottawa and Allegan. Not all shoreline counties in Michigan have a modern soil survey.

Other Wisconsin Coastal Counties.

Digitized soil surveys exist for Brown, Door, Milwaukee, Racine and Kenosha counties. Digitized surveys do not exist for Marinette, Oconto and Kewaunee counties.

Other Michigan Counties

The following Lake Michigan coastal counties in Michigan have modern, published soil surveys: Antrim (digital), Berrien, Charlevoix, Delta, Emmet, Grand Traverse, Leelanau, Mackinac, Mason, Menominee, Muskegon (digital), Oceana and Van Buren. Old, out-of-print soil surveys may be found for Manistee and Schoolcraft counties but a soil survey has never been completed for Benzie County. One is expected to be finished for Benzie within the next five years.

Indiana

There are three Lake Michigan coastal counties in Indiana: La Porte (digital), Lake (not digitized) and Porter (not digitized). All three have modern, published soil surveys available.

Illinois

There are two Lake Michigan coastal counties in Illinois: Cook and Lake. Neither have soil maps in a digital form. Both have modern, published soil surveys available.

3.6.4 Sensitive Environments: Wetlands, Floodplains, Sand Dunes, HREA, etc.

Mapping of sensitive environments occurs both through general land use/cover mapping and through special mapping efforts. There is at least partial mapping of sensitive environments for the entire Lake Michigan shoreline. Sensitive environments include wetlands, floodplains, sand dunes, steep slopes and other high risk erosion areas.

Wetlands are included in the MiRIS land use/cover inventory and the Wisconsin land use/cover maps have a digital vector wetland GIS layer. Wetland maps are also available through the National Wildlife Service, National Wetland Inventory. These different sources of maps may be at different scales and some were prepared based on satellite photos while others were prepared using traditional aerial photographic imagery. Field inspection was done by different persons at different times. Thus, comparisons can be difficult.

Floodplains (or at least flood hazard areas) are mapped through the National Flood Insurance Program (NFIP) in cooperating communities or by others for particular engineering studies. Floodplains can be interpreted from USGS or other topographic maps with partial accuracy, if a credible potential flood elevation is known.

Sand dunes are included in the MiRIS inventory and critical dunes subject to state regulation are separately mapped by the Michigan Department of Environmental Quality (MDEQ). Wisconsin recently completed the Bluff Stability/Bluff Erosion Study, in cooperation with the FEMA and NOAA for the Wisconsin Lake Michigan shoreline. This Study maps Lake Michigan bluffs and associated hazards. The Michigan DEQ has designated certain sections of Lake Michigan shoreline as High Risk Erosion Areas (HREA) and has mapped these areas for the entire Michigan shoreline of Lake Michigan. Some shoreline communities utilize this mapped information for planning and zoning purposes while others do not.

Indiana

The Indiana shoreline staff has tried to document shoreline erosion through measurement over time, but has not mapped the information.

Illinois

The Illinois shoreline along Lake Michigan is largely developed and there is no shoreline program at the state level.

3.6.5 Planimetric and Topographic Maps

Planimetric mapping shows the location of streets, structures, utility lines and water courses. There is 1999 planimetric mapping for portions of the Lake Michigan shoreline, completed as part of the Potential Damages Study. Topographic mapping, in which contour maps show elevational differences are available in a coarse depiction for the entire Lake Michigan shoreline (through the USGS quads) but only a limited number of areas have a finer depiction (such as 2' contours). The USGS quads are quite dated in some places, and updated topography at a finer scale is preferred.

In Wisconsin, there is a wide variety in planimetric maps among the coastal counties. They vary widely in scale, coordinate systems, dates and software formats. Not all counties have complete coverage, but most of the coastal cities are mapped.

Topographic maps are complete for a variety of Wisconsin counties and communities within the counties. There is little topographic mapping completed in Michigan, Indiana and Illinois besides that on old USGS quads. The exceptions are generally in coastal cities. There is no comprehensive inventory available of these maps.

3.6.6 Parcel Mapping

Parcel mapping is an important planning tool that has been employed by most cities for more than a hundred years. Parcel information has historically been recorded in hand drawn and hand written formats. In recent decades, communities with adequate resources have been preparing digital parcel records. Many communities have computerized their assessment records into databases and a substantially lower number have prepared digitized drawings on CAD or GIS systems. Because different computer software programs have been used, not all communities with digital records have prepared them in the same format. The software formats include AutoCAD, Genamap, MapInfo, CMap and Arc/Info.

Digital parcel mapping is complete on only a small portion of the Lake Michigan coastal area. Most of the areas with digital parcel maps have the mapped parcels tied to assessment databases. These counties include: Allegan County, Michigan; Brown, Door, Kenosha, Kewaunee, Milwaukee, Oconto, Ozaukee, Racine and Sheboygan counties in Wisconsin.

In order to tie parcel maps to assessment data, the parcels must be mapped in polygons, not as a series of intersecting but separate lines and a parcel number (identifier) must be attached to each parcel. The parcel number must match the assessment records. Manitowac County in Wisconsin is an example of a county with parcel mapping using only lines. Allegan County has the polygons, but not all have parcel numbers linked to the polygons yet.

3.7 Current Land Use Management Practices in Five-County Prototype Area

Land use management practices, for the purpose of this discussion, include master plans, land use regulations and capital expenditures.

According to the **New Illustrated Book of Development Definitions**, published by Rutgers University, 1993, a "master plan" is a

"comprehensive, long-range plan intended to guide the growth and development of a community or region that typically includes inventory and analytic sections leading to recommendations for the community's future economic development, housing, recreation and open space, transportation, community facilities, and land use, all related to the community's goals and objectives for these elements. State enabling legislation specifies the legal requirements of a master plan, including its preparation, contents, modifications, adoption, and implementation. Although certain plan elements may be required, there are no limits to the number or type of plan elements, area, or subplans that may comprise a master plan."

Many different terms are used as an alternative to master plan. Some common ones include: comprehensive plan, general plan, development plan, basic plan, future land use plan, growth management plan and variations of these.

Zoning is the primary tool most communities use to control land use. Other land use regulations include: subdivision regulations, lot split and condominium regulations, private road regulations, screening/buffering/landscaping regulations and others. According to the **Community Planning Handbook** (Michigan Society of Planning Officials, 1991), *"zoning regulates the use of land and is the primary regulatory tool for shaping local growth and development. Traditional zoning segregates uses into different zones or districts according to their function."* Zoning should be based on a plan in order to minimize the risk of invalidation if challenged in court. Each zone identifies uses permitted, basic lot characteristics and any special standards.

Communities spend considerable monies on park acquisition and development, water and sewer systems, roads and other infrastructure. Communities that plan their capital investments generally do so with a tool called a capital improvements program (CIP). *"A CIP is the result of the preparation and updating of a plan listing all new major public facilities to be built, substantially remodeled*

or purchased in a community within the foreseeable future." (**Community Planning Handbook**)

Land use management along the Lake Michigan shoreline occurs through a mix of state regulation and local land use controls. While state enabling legislation permits local planning and zoning, there are state laws dealing with shoreline hazard and environmentally sensitive areas. These include the Wisconsin shoreline setback and the Michigan high risk erosion area permitting program. Most Michigan communities and many Wisconsin communities administer their own zoning at the township and municipal level. Shoreline planning and zoning is more active at the county and city levels in Wisconsin and at the township and city or village levels in Michigan.

Table 1 lists the Michigan and Wisconsin communities within the project area that have adopted master plans. The table also provides information on whether the master plans address shoreline issues through goals and objectives statements. Table 2 addresses key elements of zoning ordinances of shoreline communities in the project area. Not all shoreline communities have adopted master plans and not all communities responded to requests for copies of current plans and zoning ordinances.

The following topics were examined in the available master plans of communities in the pilot project counties:

- Goals, objectives, policies. Do they address floodplain and shoreline protection?
- Floodplain protection zones. Are floodplains, shoreline bluff areas; property protection areas identified as areas requiring unique approaches?
- Public investment in hazard areas. Does the Plan suggest limiting public investment in hazard areas?
- Emphasis on protecting critical areas. Does the Plan explain that the shoreline is a critical area?
- Natural resource values. Does the Plan explain the values of natural environments for wildlife habitat and visual enjoyment?
- Mapping of sensitive environments. Does the Plan map critical dunes, high-risk erosion areas, floodplains, or wetlands?
- Stormwater management. Does the Plan advocate locating land uses that typically produce large quantities of storm water runoff away from erosion areas?
- Low density in critical areas. Does the Plan advocate a lower density of development in critical areas such as shorelines, steep slopes, wetlands and near floodplains.
- Acquisition of title or easements to sensitive lands. Does the Plan advocate, identify and prioritize areas that should be protected through public ownership or easements.

The following topics were examined for each of the available zoning ordinances:

- Date of most recent adoption or amendment to the ordinance
- Floodplain ordinance. Does the ordinance forbid occupied structures in the floodplain?
- Overlay zone. Does the ordinance identify an overlay zone on the shoreline that adds specific provisions dealing with erosion and flood protection in addition to the standards of the underlying zone?
- Setbacks. Does the ordinance provide for deep setbacks on parcels in high erosion areas?
- Lot width. Does the ordinance provide for a wider width on shoreline parcels?
- Lot depth. Does the ordinance provide for lots along shorelines to be deeper than lots of the same zone away from the shore?
- Private road ordinance. Does the ordinance permit narrower streets than required by the county road commission for public roads in order to minimize impervious surfaces?
- Private drive regulations. Does the ordinance encourage shared driveways in residential districts in order to minimize impervious surfaces?

Zoning regulations of communities in the pilot counties provide very limited protection of shoreline natural resources and properties in shoreline hazard zones. This can be seen by examining Table 3, Composite Schedule of Regulations. The Composite Schedule of Regulations summarizes the zoning requirements of the different residential zones along the shoreline for minimum lot size, setbacks, lot coverage and other characteristics.

It should be noted that the Wisconsin Shoreland Management Program also deals with lot size and buffer strips, in addition to setbacks. So Wisconsin counties will have provisions for sewered lots to have a minimum average width of 65' and minimum area of 10,000 sq. ft., and septic tank lots a minimum average width of 100' and a minimum area of 20,000 sq. ft. Under the state buffer strip provision, clear-cutting of vegetation is not permitted in a 35' strip inland of the ordinary high water mark with an exemption for a 30' wide path every 100'.

Table 1

ASSESSMENT OF MASTER PLANS OF LAKE MICHIGAN SHORELINE COMMUNITIES									
Shoreline Communities: Most recent master plan date	Goals, Objectives and Policies addressing floodplain and shoreline protection	Floodplain & Shoreline Protection Zones: floodplain, shoreline bluff areas; property protection	Limiting Public Investment in Hazard Areas	Understanding that Shoreline is a Critical Area?	Discussion of the Value of the Resource (wildlife, visual enjoyment)	Mapping of critical dunes, high-risk erosion areas, floodplains, wetlands	Locating land uses with much Storm Water Runoff away from erosion areas	Providing for Low Density in Critical Areas	Identifying Areas that Should be Protected through public ownership or easements.
Allegan County, MI 1999	Yes, goals and policies reflect understanding of need for protection of resources.	Yes, reports on floodplain and shoreline areas in the county.	Yes,acknowledge-ment of hazard areas. Public investments only for parks in these areas.	Yes, extensive discussion of natural resources and their effects on the local economy.	Yes	Yes, extensive mapping of all four areas.	Yes, indicates majority of undesirable uses are planned for inland properties, not in the floodplain.	Yes, planned for low density for majority of shoreline.	Yes, suggests that area should be targeted to purchase sensitive lands.
Casco Township: 1985	Yes, but very general language about shoreline, not floodplains	No, no specific area identified	No	Yes, limiting shoreline development to low intensity uses	Yes	No, refers to FIRM* map.	Yes	Yes, (rural estate and low density residential planned)	No
City of Douglas: 1989	Yes, goals speak to keeping development in shore areas low and out of floodplain	Yes, maps floodplain and sensitive shore areas. Speaks to sensitive design near dunes.	Yes, also encourages investment in park areas on shoreline	Yes, detailed description of why shoreline should be protected.	Yes	Yes, extensive mapping of topography, basement and septic limitation areas, high-risk erosion areas, critical dune area and floodplains	Yes, only low-density residential or public parks planned.	No	Yes, mentions turning some areas into public access
Ganges Township: 1991	Yes, but not specifically shoreline, talks of wetlands.	No	No	No, they note that their shoreline area is not a "critical dune area" recognized by the DEQ	Yes	No	No	Yes, residential planned all along Lake Michigan waterfront 100' lot widths, no other restrictions	No

ASSESSMENT OF MASTER PLANS OF LAKE MICHIGAN SHORELINE COMMUNITIES									
Shoreline Communities: Most recent master plan date	Goals, Objectives and Policies addressing floodplain and shoreline protection	Floodplain & Shoreline Protection Zones: floodplain, shoreline bluff areas; property protection	Limiting Public Investment in Hazard Areas	Understanding that Shoreline is a Critical Area?	Discussion of the Value of the Resource (wildlife, visual enjoyment)	Mapping of critical dunes, high-risk erosion areas, floodplains, wetlands	Locating land uses with much Storm Water Runoff away from erosion areas	Providing for Low Density in Critical Areas	Identifying Areas that Should be Protected through public ownership or easements.
Laketown Township: 1996	Yes, both shoreline and floodplain protection addressed	Yes, diagrams 100' landward setback of a dune area.	No	Yes, shows diagrams of bluffs and provides an explanation of why it is important to protect.	Yes	No, refers to FIRM* map.	Yes, doesn't discuss in detail, but does provide rural and low-density residential area off of shoreline.	Yes (rural estate and low density residential planned)	No
City of Saugatuck: 1989	Yes, waterfront protection is mentioned to limit intense development	Yes, maps floodplain and sensitive shore areas. Speaks to sensitive design near dunes.	Yes, encourages investment in park areas on shoreline	Yes, detailed description of why shoreline should be protected.	Yes	Yes, extensive mapping of topography, basement and septic limitation areas, high-risk erosion areas, critical dune area and floodplains.	Yes, only low-density residential or public parks planned.	Yes, low-density residential development areas planned for shoreline areas at one unit per five acres.	Yes, lands set aside for public access to lakefront areas in future land use plan
Saugatuck Township: 1989	Yes, goals speak to keeping development in shore areas low and out of floodplain	Yes, maps floodplain and sensitive shore areas. Speaks to sensitive design near dunes.	Yes, encourages investment in park areas on shoreline	Yes, detailed description of why shoreline should be protected.	Yes	Yes, extensive mapping of topography, basement and septic limitation areas, high-risk erosion areas, critical dune area and floodplains	Yes, only low-density residential or public parks planned.	Yes, low-density residential development areas planned for shoreline areas at one unit per five acres.	Yes, lands set aside for public access to lakefront areas in future land use plan

ASSESSMENT OF MASTER PLANS OF LAKE MICHIGAN SHORELINE COMMUNITIES									
Shoreline Communities: Most recent master plan date	Goals, Objectives and Policies addressing floodplain and shoreline protection	Floodplain & Shoreline Protection Zones: floodplain, shoreline bluff areas; property protection	Limiting Public Investment in Hazard Areas	Understanding that Shoreline is a Critical Area?	Discussion of the Value of the Resource (wildlife, visual enjoyment)	Mapping of critical dunes, high-risk erosion areas, floodplains, wetlands	Locating land uses with much Storm Water Runoff away from erosion areas	Providing for Low Density in Critical Areas	Identifying Areas that Should be Protected through public ownership or easements.
Ottawa County, MI: 1992	Yes, goals note a balance between development and protection of natural resources.	The plan notes that most communities in Ottawa County already restrict development within the floodplain. Bluff protection is only mentioned with regard to the state law overseeing local zoning in the critical areas.	Yes, states that the county or local governments should consider purchasing sites of environmental significance.	Yes, an understanding of how much the economics of the region depends on the natural character in the county.	Yes	Yes, mapping of critical dunes, wetlands and floodplains.	No, this plan leaves those details up to the local government.	No, this plan leaves those details up to the local government.	Yes, generally states that the county and local governments should acquire fragile properties.
City of Ferrysburg, MI: 1991	Yes, notes development should be sensitive to critical dune area	No, Ferrysburg has chosen not to enact the critical dune ordinance.	No	Yes, in goals suggests that shoreline should be protected.	Yes	Yes, one map of all four environmental zones	Yes, only low-density residential	Yes, low density residential along critical dune area.	Yes, public access recommended, but not many areas available.
City of Grand Haven, MI: 1989	Yes, sensitive to environmental features	Yes, because it is in the Grand River watershed area. Bluffs area largely owned by the city.	Yes, encourages investment in park areas on shoreline	Yes, detailed description of why shoreline should be protected.	Yes	Yes, mapping of floodplains, sensitive lands, wetlands	No, but there is talk of the negatives of runoff, but only in relation to wetlands.	Mixed, sensitive areas are city owned and protected, while some property immediately adjacent is planned for high density residential.	Yes, public space planned for entire shorefront

ASSESSMENT OF MASTER PLANS OF LAKE MICHIGAN SHORELINE COMMUNITIES									
Shoreline Communities: Most recent master plan date	Goals, Objectives and Policies addressing floodplain and shoreline protection	Floodplain & Shoreline Protection Zones: floodplain, shoreline bluff areas; property protection	Limiting Public Investment in Hazard Areas	Understanding that Shoreline is a Critical Area?	Discussion of the Value of the Resource (wildlife, visual enjoyment)	Mapping of critical dunes, high-risk erosion areas, floodplains, wetlands	Locating land uses with much Storm Water Runoff away from erosion areas	Providing for Low Density in Critical Areas	Identifying Areas that Should be Protected through public ownership or easements.
Grand Haven Township, MI: 1996	Use of zoning to protect "environmental quality" and important environmental features.	No	No	General, no explicit language	Yes	No	No	No, medium densities planned for entire shoreline.	Yes, plan for public space along shore.
City of Holland: 1992	No	No	No	No	Yes	No	No, industrial adjacent to lake	No	No
Holland Township, MI: 1999	Yes, generally to "preserve sensitive environment features"	No	No	No	Yes	Yes, except erosion areas.	No, industrial and commercial adjacent to lake.	No	Yes, says that there should be some public access to lake, but doesn't set aside land in future land use plan.
Park Township, MI: 1998	Yes, protection of ecological value and open space	No	Yes, encouraging parks	Yes, provides an explanation of why it is important to protect.	Yes	No	Yes, low density residential planned	Yes, residential density of 1 unit per acre	Yes, lots of recommendations for public space easements and access
Port Sheldon Township, MI	NA								

ASSESSMENT OF MASTER PLANS OF LAKE MICHIGAN SHORELINE COMMUNITIES									
Shoreline Communities: Most recent master plan date	Goals, Objectives and Policies addressing floodplain and shoreline protection	Floodplain & Shoreline Protection Zones: floodplain, shoreline bluff areas; property protection	Limiting Public Investment in Hazard Areas	Understanding that Shoreline is a Critical Area?	Discussion of the Value of the Resource (wildlife, visual enjoyment)	Mapping of critical dunes, high-risk erosion areas, floodplains, wetlands	Locating land uses with much Storm Water Runoff away from erosion areas	Providing for Low Density in Critical Areas	Identifying Areas that Should be Protected through public ownership or easements.
Spring Lake Township: 1998	Yes, understanding of importance but no goal specifically saying "protect these areas"	Yes, maps floodplain and sensitive shore areas. Speaks to sensitive design near dunes	Yes, encourages investment in park areas on shoreline	Yes, understanding of its importance to their economy	Yes, Spring Lake has watershed guide for residents and surrounding areas.	Yes all four areas mapped in detail.	Yes, industrial located inland	Yes, shore areas planned for low-density residential and rural estate.	Yes, some shore land set aside in plan for public use.
South Haven: 1995	Yes, goals speak to keeping development in shore areas low	Yes, maps floodplain and sensitive shore areas.	Yes, encourages investment in park areas on shoreline	Yes, detailed description of why shoreline should be protected.	Yes	Yes, extensive mapping of topography, basement and septic limitation areas, high-risk erosion areas, critical dune area and floodplains	Yes, only low-density residential or public parks planned.	Yes, some existing multi-family residential on shoreline. Low density residential and parks planned.	Yes, encourages purchasing public access and limiting heights of structures for views
Sheboygan County, WI	NA								
City of Sheboygan, WI	NA								
Manitowoc County, WI	NA								
City of Manitowoc, WI	Yes, plan in progress								
City of Two Rivers, WI	No plan								
Ozaukee County, WI	NA								
Port Washington, WI	NA								

*Firm = Flood Insurance Rate Map

NA = Plan was not available to review

Table 2

ASSESSMENT OF ZONING ORDINANCES OF LAKE MICHIGAN SHORELINE COMMUNITIES								
Shoreline Communities: date of most recent adoption or amendment of ordinance	Floodplain Ordinance; forbidding structures in floodplain	Overlay Zone for shoreline erosion protection*	Overlay Zone for flood protection	Deep Setbacks on Parcels in High Erosion Areas	Wider Width on Shoreline Parcels	Minimum Lot Depth	Private Road Ordinance for narrower streets (less impervious surface)	Private Drive Regulations; encouraging shared driveways (minimizing impervious surfaces)
Allegan County, MI (no County zoning)								
Casco Township, MI: 1998	Yes, general language regarding floodplain areas and hazards.	No	No	Yes somewhat, (rural estate and low density residential planned) 150' from the bluff.	Yes somewhat, (rural estate and low density residential planned) 85' to 150'	No	No	No
City of Douglas, MI: 1998	Yes, floodplain included in environmental protection standards. Forbids new construction within sensitive areas.	Yes, creates shoreline protection strip of 30' for new development along shore.	No	Yes, (low density residential planned) 50' from high water mark.	No	No	No	No
Ganges Township, MI: 1998	No	No	No	No	No, (wider width required on inland Hutchens Lake, however)	No	No	No
Laketown Township, MI: 1981	Yes, general language regarding floodplain areas and hazards.	No	No	Yes (rural estate and low density residential planned) 50' from lot line	Yes, (rural estate and low density residential planned) 100' to 200'	No	No	No
City of Saugatuck, MI: 1986	Yes, floodplain overlay district restricts properties within the 100 year floodplain	No	Yes, floodplain overlay district, preempts other use regulations in that district	Yes, 90 ft. from bluff line.	Min lot width on lakefront = 100'	No	No	No

ASSESSMENT OF ZONING ORDINANCES OF LAKE MICHIGAN SHORELINE COMMUNITIES								
Shoreline Communities: date of most recent adoption or amendment of ordinance	Floodplain Ordinance; forbidding structures in floodplain	Overlay Zone for shoreline erosion protection*	Overlay Zone for flood protection	Deep Setbacks on Parcels in High Erosion Areas	Wider Width on Shoreline Parcels	Minimum Lot Depth	Private Road Ordinance for narrower streets (less impervious surface)	Private Drive Regulations; encouraging shared driveways (minimizing impervious surfaces)
Saugatuck Township, MI: 1987	Yes, floodplain overlay district restricts properties within the 100 year floodplain	No	Yes, floodplain overlay district, preempts other use regulations in that district	Yes, 90 ft. from bluff line.	Min lot width on lakefront = 100'	No	No	No
South Haven, MI: 1998	Yes, 100 year floodplain subject to special regulations.	Yes, erosion overlay zone prevents the placement of structures in high-risk areas. Boundaries on zoning map.	Yes, floodplain overlay zone	Yes, 85 to 200 feet from bluff line depending on risk area.	No	No	No	No
Ottawa County (no County zoning)								
City of Ferrysburg, MI	NA							
City of Grand Haven, MI: 1998	Yes, sensitive areas district restricts building in floodplain without permission from the MDEQ.	Yes, sensitive areas district encompasses floodplain, wetlands and shoreline. Guidelines restrict single-family housing but do offer cluster-housing options.	Yes, sensitive areas district encompasses slopes	No	No	No	No, but does require oil traps to protect from runoff.	No
Grand Haven Township, MI: 1999	Yes, floodplain ordinance restricting building in the flood plain unless you meet standards in floodplain overlay zone.	No	Yes, overlay zone for floodplain	No	No	No	No	No
City of Holland, MI: 1995	Yes, floodplain districts; no buildings for dwelling purposes.	No	No	No	No	No	No	No
Holland Township, MI: 1991	Yes, floodplain districts; no buildings for dwelling purposes.	No	No	No	No	No	No	No

ASSESSMENT OF ZONING ORDINANCES OF LAKE MICHIGAN SHORELINE COMMUNITIES

Shoreline Communities: date of most recent adoption or amendment of ordinance	Floodplain Ordinance; forbidding structures in floodplain	Overlay Zone for shoreline erosion protection*	Overlay Zone for flood protection	Deep Setbacks on Parcels in High Erosion Areas	Wider Width on Shoreline Parcels	Minimum Lot Depth	Private Road Ordinance for narrower streets (less impervious surface)	Private Drive Regulations; encouraging shared driveways (minimizing impervious surfaces)
Park Township, MI: 1995	No, only restriction is for properties that touch a body of water, calls for 50' from rear lot line.	No	No	50' from rear lot line.	Mixed, some larger lots, some medium density and PUD's. PUD: width varies R-2: 100' R-1: 85'	No	No	No
Port Sheldon Township, MI: 1998	Yes, flood damage prevention ordinance	High risk erosion zone and critical dune district limit placement and intensity of any potential development.	Yes, flood prevention ordinance for 100 year floodplain	Yes, 85 to 235 ft. from bluff line depending on risk area.	Min. 100'	No	No	No
Spring Lake Township, MI: 1999	Yes, floodplain district in which no building can be built and used for dwelling purposes.	No	Yes, floodplain protection district	Yes, 100 ft. from bluff line.	100'	No	No	No
Manitowoc County, WI	Yes, floodplain zoning ordinance, which established a Floodway District (no human habitation allowed) and a Flood fringe District (in which human habitation is conditional), other uses are allowed in either district (for example: agriculture, open space or temporary structures.	Conservancy District preserves open space in wetland, floodplain, erosion control areas, etc. Only "special uses" allowed, such as parks and golf courses. Shoreland-Wetland Zoning District that preempts other use regulations it that district. All wetlands must be greater than 5 acres before they are regulated. Shoreland is defined to be land within 1,000 feet of a lake and 300 feet of a river.	Floodplain District: which breaks into different levels of flood fringe, floodway and general floodplain offer conditional uses based on area. However, no new construction for human habitation.	May be subject to greater setbacks, does not specify an exact figure, subject to zoning administrator approval. Depends on stable slope angle and recession rate.	150'	No	No	No

ASSESSMENT OF ZONING ORDINANCES OF LAKE MICHIGAN SHORELINE COMMUNITIES

Shoreline Communities: date of most recent adoption or amendment of ordinance	Floodplain Ordinance; forbidding structures in floodplain	Overlay Zone for shoreline erosion protection*	Overlay Zone for flood protection	Deep Setbacks on Parcels in High Erosion Areas	Wider Width on Shoreline Parcels	Minimum Lot Depth	Private Road Ordinance for narrower streets (less impervious surface)	Private Drive Regulations; encouraging shared driveways (minimizing impervious surfaces)
City of Manitowoc, WI: 1999	Yes, floodplain-zoning ordinance, which established a Floodway District (no human habitation allowed), and a Flood fringe District (in which human habitation is conditional) other uses are allowed in either district (for example: agriculture, open space or temporary structures.	Conservancy District preserves open space in wetland, floodplain, erosion control areas, etc. Only "special uses allowed, such as parks and golf courses. Shoreland-Wetland Zoning District that preempts other use regulations in that district. All wetlands must be greater than 5 acres before they are regulated. Shoreland is defined to be land within 1,000 feet of a lake and 300 feet of a river.	Floodplain District: which breaks into different levels of flood fringe, floodway and general floodplain offer conditional uses based on area. However, no new construction for human habitation.	75'	150'	No	No	No
City of Two Rivers, WI: 1999	Yes, floodplain-zoning ordinance, which established a Floodway District (no human habitation allowed), and a Flood fringe District (in which human habitation is conditional) other uses are allowed in either district (for example: agriculture, open space or temporary structures.	Shoreland-Wetland Zoning District that preempts other use regulations in that district. All wetlands must be greater than 5 acres. Shoreland is defined to be land within 1,000 feet of a lake and 300 feet of a river.	Floodplain District: which breaks into different levels of flood fringe, floodway and general floodplain offer conditional uses based on area. However, no new construction for human habitation.	May be subject to greater setbacks, does not specify an exact figure, subject to zoning administrator approval.	No	No	No	No
Ozaukee County, WI	NA			Stable slope angle from toe of bluff.				
Port Washington, WI	NA							

ASSESSMENT OF ZONING ORDINANCES OF LAKE MICHIGAN SHORELINE COMMUNITIES								
Shoreline Communities: date of most recent adoption or amendment of ordinance	Floodplain Ordinance; forbidding structures in floodplain	Overlay Zone for shoreline erosion protection*	Overlay Zone for flood protection	Deep Setbacks on Parcels in High Erosion Areas	Wider Width on Shoreline Parcels	Minimum Lot Depth	Private Road Ordinance for narrower streets (less impervious surface)	Private Drive Regulations; encouraging shared driveways (minimizing impervious surfaces)
Sheboygan County, WI: 1999	Yes, floodplain-zoning ordinance, which established a Floodway District (no human habitation allowed), and a Flood fringe District (in which human habitation is conditional) other uses are allowed in either district (for example: agriculture, open space or temporary structures.	Shoreland-Wetland Zoning District that preempts other use regulations in that district. All wetlands must be greater than 5 acres. Shoreland is defined to be land within 1,000 feet of a lake and 300 feet of a river.	Floodplain District: which breaks into different levels of flood fringe, floodway and general floodplain offer conditional uses based on area. However, no new construction for human habitation.	100' south of City of Sheboygan and 225 ft. north of City of Sheboygan.	No	No	No	No
City of Sheboygan, WI	NA							

* Overlay Zone for shoreline protection can include a High Risk Overlay Zone or Critical Dune Overlay Zones. Only Port Sheldon's High Risk Overlay Zone and Critical Dune Overlay Zone has been approved by the State of Michigan DEQ, South Haven's ordinance is being reviewed. The rest of the Overlay Zones are strictly local ordinances.

NA = Ordinance not available to review

Table 3

RESIDENTIAL ZONING REGULATIONS IN SHORELINE DISTRICTS					
Schedule of Regulations for Residential Shoreline Districts	Residential District	Lot Size	Minimum Lot Width	Lot Coverage	Setback
Allegan County, MI (no County zoning)					
Casco Township, MI: 1998	Rural Estate	1 acre	150'	No restrictions	150' from bluff
	Low Density Residential (LDR)	12,000 sq. ft.	85'	No restrictions	150' from bluff
City of Douglas, MI: 1998	Single Family Residential R-2	7,920 sq. ft.	75'	35%	50' from high water mark
Ganges Township, MI: 1998	Residential	No restrictions	100'	No restrictions	No restrictions
City of Saugatuck, MI: 1986	Lakefront Residential	20,000 sq. ft.	100'	No restrictions	90' from bluffline
	Floodplain overlay (separate river flood district)	No new construction except conditional uses.			
Saugatuck Township, MI: 1987	Lakefront Residential	20,000 sq. ft.	100'	No restrictions	90' from bluffline
	Floodplain overlay (separate river flood district)	No new construction except conditional uses.			
	High risk erosion overlay zone	20,000 sq. ft.	100'	No restrictions	90' from bluffline
South Haven, MI: 1998	LDR	8,400 sq. ft.	70'	35%	25' from rear lot line
	Erosion and Overlay Zone	No specific guidelines. Follow zoning ordinance for that parcel.	No specific guidelines. Follow zoning ordinance for that parcel.	No specific guidelines. Follow zoning ordinance for that parcel.	85' to 200' setback depending on erosion risk area
Ottawa County, MI (no County zoning)					
Ferrysburg, MI	NA				
City of Grand Haven, MI: 1998	R-1	35,000 sq. ft.	150'	30%	35' from rear lot line
	R-2	10,500 sq. ft.	75'	30%	25' from rear lot line
	SA: Sensitive Areas	Includes protection of wetlands, floodplain areas and dunes. No single family housing allowed, only cluster housing: with various options of density subject to zoning administrator approval.			
Grand Haven Township, MI: 1999	Residential-1	15,000 sq. ft.	100'	No restrictions	50' from rear lot line
	Floodplain overlay	No new construction except conditional uses.			
City of Holland, MI: 1995	R-1	8,400 sq. ft.	70'	No restrictions	25' from rear lot line
	R-2	7,200 sq. ft.	60'	No restrictions	25' from rear lot line
	R-3	5,000 sq. ft.	50'	No restrictions	25' from rear lot line
Holland Township, MI: 1991	LDR	10,500 sq. ft.	70'	35%	50' from rear lot line
	MDR	8,400 sq. ft.	70'	35%	50' from rear lot line
Laketown Township, MI: 1981	Rural Estate	2.5 acres	200'	No restrictions	40' from rear lot line
	LDR	12,500 sq. ft.	100'	No restrictions	50' from rear lot line
Park Township, MI: 1995	R-2	43,560 sq. ft.	100'	No restrictions	50' from rear lot line
	R-4	8,500 sq. ft.	85'	No restrictions	50' from rear lot line

Table 3

RESIDENTIAL ZONING REGULATIONS IN SHORELINE DISTRICTS					
Schedule of Regulations for Residential Shoreline Districts	Residential District	Lot Size	Minimum Lot Width	Lot Coverage	Setback
Port Sheldon Township, MI: 1998	Residential	20,000 sq. ft.	100'	No restrictions	40'
	High risk erosion overlay zone	No specific guidelines. Follow zoning ordinance for that parcel.	No specific guidelines. Follow zoning ordinance for that parcel.	No specific guidelines. Follow zoning ordinance for that parcel.	85' to 235' depending on erosion risk zones.
	Critical dune district	40,000 sq. ft.	100'	30%	100' from first landward ridge
Spring Lake Township, MI: 1999	LDR	10,000 sq. ft.	100'	Max lot coverage is 20% of the total lot area.	100' from bluffline
Manitowoc County, WI	Shoreland-Wetland District	1 acre	150'	No restrictions	May be subject to greater setbacks, does not specify an exact figure, subject to zoning administrator approval.
	Floodplain District	No new construction except conditional uses.			
City of Manitowoc, WI: 1999	Shoreland-Wetland District	43,560 sq. ft.	150'	No restrictions	75' from bluffline
	Floodplain District	No new construction except conditional uses.			
City of Two Rivers, WI: 1999	Shoreland-Wetland District	No restrictions	No restrictions	No restrictions	300' from the high water mark
	Floodplain District	No new construction except conditional uses.			
Ozaukee County	NA				Based on stable slope angle and recession rate.
Port Washington, WI	NA				
Sheboygan County, WI: 1999	Shoreland-Wetland District	No restrictions	No restrictions	No restrictions	100' south of City of Sheboygan and 225' north of City of Sheboygan (from bluffline)
	Floodplain District	No new construction except conditional uses.			
City of Sheboygan, WI	NA				

Zoning

The local zoning ordinance is the primary regulatory tool that the communities use to determine where different types of land uses may locate within the community and acceptable characteristics of those uses, such as minimum dimensions of parcels, distance of structures from property lines, percent coverage of a parcel and many others.

Zoning ordinances are important in hazard areas because they can direct certain vulnerable types of development out of hazard areas and, to some extent, limit the affect of development on natural features through the regulation of how properties are developed. Thus, the most important feature is whether there is a set of floodplain and/or erosion hazard regulations. In addition, basic regulations on lot size, minimum lot width, minimum lot depth, setbacks and lot coverage can also have a significant affect on reducing the vulnerability of structures in hazard areas.

Floodplain and Erosion Hazard Overlay Zones

The most common way communities apply floodplain and/or erosion hazard regulations in shoreline areas is via overlay zones. An overlay zone is a set of regulations that apply to a specific geographic area (which is usually mapped) in addition to all the requirements of the underlying zone. Thus, a home or lot in an R-1 residential zone, must meet the use, area, height, coverage and setback requirements of the R-1 zone, plus any regulations that apply to homes in a floodplain, if the lot is located in an identified floodplain. The same would be true for a house in an R-1 zone that is on a lot in a designated high risk erosion zone. Some communities apply floodplain and high risk erosion regulations without mapping them. When this is done, they are described as a separate set of standards that must be met for development on lots in identified floodplain or high risk erosion areas. Essentially then, the effect is the same as overlay zoning. Thus, where Tables 2 and 3 refer to overlay zoning, it is applied whether or not there is a mapped "overlay zone".

Lot Size

Many communities place minimum lot size limits on particular zoning districts so that the density of residents does not overwhelm the infrastructure or negatively affect quality of life. A larger lot size can also translate into fewer endangered homes in a hazard area, a smaller percentage of imperviousness and, potentially, a smaller pollutant load on the environment.

Within the shoreline areas of the study counties, minimum lot size ranges from 5,000 sq. ft. (R-3 Zoning District, City of Holland) to 2.5 acres (Rural Estate Zoning District, Laketown Township). If, in the City of Holland R-3 district, there was extensive development where there were natural hazards, potential damages could be high. Both urban Wisconsin communities with local zoning

have minimum lot size requirements of 1 acre. This large lot size would help limit potential damages if there is a wide minimum lot width as well.

In communities in Wisconsin under state-mandated zoning, minimum lot size is 10,000 square feet where served by public sewer and 20,000 square feet where not served by public sewer. These lots are small to medium sized as far as shoreline hazards are concerned.

Minimum Lot Width

The spacing of structures is controlled, in part, by regulated lot width. A wide minimum lot width in a hazard area helps limit the number of buildings subjected to natural hazards. It also helps to limit imperviousness and thereby reduce concentrations of surface water that can increase bluff groundwater in isolated locations, reduce localized erosion problems and reduce stormwater contributions to streams or rivers that flood.

Of communities within the study area that have zoning ordinances, minimum lot width requirements range from 50' (R-3 Zoning District, City of Holland) to 200' (Rural Estate Zoning District, Laketown Township). The R-3 minimum lot width of 50' concentrates many buildings in one area. If a portion of this district were to be in a hazard area, a greater level of damage could occur from a flood or shoreline erosion. In both urban Wisconsin communities with local zoning, the minimum lot width for the districts that include shorelines is 150'. There is some benefit to this minimum lot width in serving to reduce potential damages. In other Wisconsin communities under state-mandated zoning, minimum lot width is 65' where served by public sewer and 100' where not served by public sewer. These lots are small to medium sized as far as shoreline hazards are concerned.

Minimum Lot Depth

None of the communities examined have a minimum lot depth standard. However, in an area prone to flooding or at high risk of erosion, a deeper than average lot is a big plus. It permits a deeper setback in the first place, and room to move or relocate a structure over time. A lot width to depth ratio (a common standard) of 1:3 or 1:4 may be inadequate in high risk erosion areas. A variance or exception process to permit 1:5 or 1:6 ratio lots should be considered in high risk erosion areas.

Setbacks (see also discussion in 3.1-3.6)

Setbacks can serve to require buildings be placed away from hazard areas such as floodplains and eroding bluffs. Although buildings on riparian lots tend to "face the water," the property line that is generally closest to the water is often called the rear property line. Therefore, rear setbacks (and hazard line setbacks) serve as the important setback. In some areas, because hazards generally do not conform to property lines, the setback may reference a particular, designated hazard line.

Setbacks are employed in all shoreline communities, through local ordinance or state-mandated setback. Setbacks in the study area community ordinances range from 25' to 150'. Two communities have Erosion Overlay Zones, in which there is a range of setbacks from 85' to 235', depending on the risk area. These are Port Sheldon Township and the City of South Haven. In Wisconsin, building setback is a minimum of 75' from the ordinary high water mark unless an existing development pattern exists and except for piers, boat houses and boat houses. Recent legislation also permits certain, open accessory structures such as gazebos, within 35' of the ordinary high water line. As can be seen from Table 3, Sheboygan County imposes a 100' to 225' setback from the bluffline and the City of Two Rivers imposes 300' setback from the ordinary high water mark. While municipalities in Wisconsin are not required to adopt setbacks, the City of Manitowoc requires a 75' setback from the bluffline and Two Rivers, as mentioned above, also has a setback requirement.

Lot Coverage

Lot coverage means the amount of impervious surface or building area permitted on a parcel. A large lot coverage means there is little natural vegetation or soil uncovered by buildings or parking lots. A high lot coverage can affect damage potential by accelerating bluff slumping (Wisconsin DNR, 1999) and by exposing a greater size of paved area and structures subject to damaging forces, such as flooding or collapse. The greater the lot coverage permitted, the greater the potential damages.

Lot coverage requirements in the study area communities range from no restrictions (fifteen of the communities), to a maximum of 30% (Ganges Township). Given the lack of lot coverage requirements among the study communities, there appears to be considerable opportunity for development that increases the risk for potential damage.

Private Roads and Private Drives

Private road and private drive regulations were not found in existing zoning regulations of any of the study communities. This may mean there are none, or it may be that such regulations exist in separate ordinances but not in the zoning ordinance. Private road and private drive regulations can reduce the amount of impervious surface on a lot (much like lot coverage requirements) where road widths are narrow and driveways are shared. Thus, encouraging greater use of both of these techniques would further reduce potential damages from new development along the shoreline.

Land Division, Subdivision and Condominium Regulations

To the extent that land division, subdivision and condominium regulations reflect the same or complimentary regulations to those described above (from local zoning regulations) there will be the same positive or negative impacts on potential shoreline damages. However, such regulations are not as common as zoning regulations in rural areas. It will be important that future studies also

examine the extent to which land division, subdivision and condominium regulations are in place, are consistent with local zoning regulations and incorporate or leave out standards that would minimize damages from shoreline development. Of particular importance are provisions related to lot width and depth, road and other infrastructure standards, and the relationship of new lots to other contiguous developments.

4.0 FLOOD ELEVATIONS/FLOOD PROOFING/HAZARD MITIGATION

4.1 Overview

Natural disasters that people in the United States face include earthquakes, tornadoes, hurricanes and major storms, flooding and wildfire. Within the Lake Michigan basin, the most prevalent natural disasters are flooding and shoreline erosion. There are also risks of tornado, wildfire and earthquake, with the latter two disasters less common or severe than in other parts of the nation. The hazards of primary importance to this study are flooding and shoreline erosion. Shoreline erosion occurs on both salt water and fresh water coasts. Hurricane force winds are not needed for shoreline erosion to take place on fresh water coasts.

While natural disaster-related damage can severely affect Lake Michigan communities, the scale and geographic range of damage is smaller than along the major continental rivers, salt water shores and earthquake-prone areas. It is from the experiences of these latter regions that much of the literature derives about dealing with natural disasters.

The discussion of flood elevations and flood proofing in the 1993 IJC Report makes the following important points:

- Flood elevations (those estimated by FEMA or other agencies) can be used in managing both new development and retrofitting existing development to limit flood damage.
- Floodproofing includes both low-cost and more expensive measures to prevent intrusion of flood waters into structures.
- Raising structures on stilts or mounds of earth can help floodproof structures but retains a developed use of the floodplain.
- The most commonly used elevation for regulating development in the floodplain is that of the 100 year flood for the particular floodplain.
- New building codes frequently include floodproofing measures.
- Relocation of buildings out of the floodplain is an important option.
- A riparian survey indicated only about 16% of structures in floodplains had been raised or reinforced to withstand floodwaters.
- Wave run-up provisions are included in the NFIP although there is no information on how that was applied in the affected states.
- Where floodproofing efforts took place, in a study of 10 American cities, elevating buildings or raising them on fill was the predominate response.

The federal government oversees planning for and responding to disasters through legislation and executive orders that forms disaster policy. The three most important are:

- 1979-Creation of the Federal Emergency Management Agency (FEMA) to consolidate activities of a variety of agencies through a series of executive orders. FEMA responds to natural disasters after a Presidential declaration of

a disaster that transcends the ability of local and state governments to respond.

- 1988-Robert T. Stafford Disaster Relief and Emergency Assistance Act (P.L. 93-288, as amended) establishes cost-sharing requirements for public assistance programs, provides funds for states and local governments for project management and provides grants for hazard mitigation efforts and planning.
- 1994-National Flood Insurance Reform Act (P.L. 103-325) establishes a flood mitigation fund to provide flood planning and mitigation assistance grants to state and local governments and new insurance coverage for the higher costs of compliance with NFIP mitigation requirements.

It should be noted that only about 1 percent of all disasters receive a Presidential declaration. (Schwab et al, APA, 1999)

It is also important to note that the 1993 IJC Report and documents prepared by the Federal Emergency Management Agency (FEMA) reference the 100 year floodplain. Reliance on the 100 year floodplain may not provide sufficient protection considering the potential extreme highs on Lake Michigan are more on the order of a 500 year flood. The experience of local and federal officials following the 1993 floods of the Mississippi River and tributaries was that citizens expected that flood protection regulations and structures would protect them from any flood. Most regulations in that region referenced 100-year floods and most flood control structures were designed for 100-year floods. In 1993, the Mississippi River reached two 500-year floods within the same year (Schwab et al, APA 1998). Nature can be even more insensitive to statisticians. In Gulf Shores, Alabama, three 1,000-year storms have occurred since 1906 (Rogers, 1991). Thirty-five percent of flood insurance claims go to properties outside the 100-year floodplain (Schawb et al, APA, 1998).

The projections of possible high Lake Michigan levels developed by the US Army Corps of Engineers in 1999 establish 585.5' as a possible high lake level. This is the equivalent of about a 500-year flood (USACE, 1999).

States and counties have formed planning structures for dealing with natural disasters. Generally, hazard plans focus on warning residents of impending natural disasters, implementing temporary protective structures such as sand-bag barriers, directing people to shelters out of the hazard zone, evacuating persons trapped by the natural disaster and providing aid to injured or homeless persons. These plans maybe inadequate in the face of the new higher possible lake level.

A summary of legislation in states bordering Lake Michigan authorizing regulation of structures in floodplains is contained in section 9.0 Shoreline Alteration Requirements/Shoreline Legislation (State level).

4.2 Hazard Mitigation

Hazard mitigation is the practice of trying to limit future damages due to natural disasters. The three basic approaches to hazard mitigation are to:

- Construct protective devices to protect private property from the effects of the disaster. An example of this approach is building levees along flood prone rivers.
- Require new and replacement construction of damaged buildings to be built with stricter building codes to allow the structures to withstand the natural force with far less damage. Examples include raised structures where high water can be a problem and roof ties where the problem may be hurricane force winds.
- Move capital intensive commercial, public or industrial and residential structures out of harms way. In this approach, buildings are torn down and rebuilt elsewhere or are moved to a new, safer location. The hazard locations are then used for parks or preserves and only low-cost structures, such as picnic structures are erected there. In addition, future construction is limited to safe locations.

The nation-wide experience is that most hazard mitigation efforts are directed at surviving future disasters while maintaining populations and development within the hazard zones. There is very little mitigation directed at removing people and investments from the hazard zone, although this third approach is used by some communities.

All levels of government engage in activities and programs that tend to promote resettlement of damaged areas or continued development of hazard zones. Local governments grant permits to re-build damaged homes and businesses, even when the structures are located within a hazard zone. State and federal agencies provide grants or loans (HUD) to rebuild homes and businesses and infrastructure (Department of Transportation) damaged by floods. However, some branches of the federal government are promoting abandonment of the hazard zones. Unfortunately, other branches support contrary initiatives, such as the re-occupation of damaged communities.

Part of the problem arises when temporary disaster responses become permanent. This can be true of temporary housing, restored utilities, repaired roads and re-opened bridges. (Schwab et al, APA 1999)

Local governments, especially, promote the re-occupation or the initial development of hazard zones. This is because:

- They tend to discount risks unless they have direct experience with damages.
- There are other issues of greater priority in local decision-making, (e.g. enlarging the tax base).
- Hazard areas are often highly valuable economic resources.

- Hazard areas are often already built out, making remedial action costly and politically difficult.

There is a model hazard area ordinance available from the American Planning Association (Schwab et al, PAS Report 483/484 1998) that provides local communities with a regulatory tool to help manage responses to property damage following natural disasters.

4.2.1 State Disaster Planning

Disaster planning and emergency management at the state level is often a function of the State Police.

Michigan's hazard management plan reviews each of the legislative acts that have been adopted to mitigate for hazards along the Great Lakes shoreline: high-risk erosion areas, flood areas and environmental areas. It also lists major state flooding problems through the past decades.

The following information is available in the plan:

- Hazard description of shoreline flooding and erosion
 - The Plan includes a map of Great Lakes shoreline flooding and erosion hazard areas but this is highly generalized and contains a disclaimer to the effect that not all hazard areas are shown. The entire study area is shown as a high risk erosion area but there is no flood hazard area identified within the study counties in Michigan.
 - Natural ups and downs in lake levels
 - Man-made changes from power generation, dams, or dredging.
- Significant periods of shoreline erosion
 - 1985-86 disaster declaration for high water levels in 17 Michigan shoreline counties.
 - 1972-73 high water levels caused flooding in 30 counties, with thousands of people forced to evacuate from their homes.
 - Early 1950's and late 1960's, similar high water level flooding.
- Programs
 - Shorelands Protection and Management, Part 323 of Act 451 P.A. 1994.
 - Identifies high risk erosion areas, environmental areas, and flood risk areas. Regulations developed for management of these areas.
 - National Flood Insurance Program
 - Officials from MDEQ estimate only 15% of floodprone structures in Michigan that are eligible for flood insurance have purchased flood insurance.
 - USACE Advance Measures Program to provide "self-help" materials at a 100% federal cost share for such items as sandbags, sand and plastic sheeting to help construct temporary dikes. This program and its predecessor, Operation Foresight, were implemented during the last three

high water periods on the Great Lakes, primarily in the Lake Erie, Lake St. Clair and Saginaw Bay areas.

- Community Education
 - MDEQ programs for realtors, insurance agents, etc.
- Shoreland Community Protection Program, Emergency Home Moving Program and Emergency Flood Protection Program were established during the high water periods of 1986-1988. These programs are not currently in existence.

The Upton-Jones Amendment to NFIP was adopted in 1987. This program was targeted at erosion damage along the Great Lakes. Claims could be made in advance of damage to provide for demolition of structures that were about to collapse or for relocation. Upton-Jones was not renewed.

Michigan Emergency Home Moving Program: program only ran for two years in 1985 to 1987. This was a special project of the Michigan Legislature, not a part of Upton Jones federal program. The Emergency Home Moving Program was appropriated 2 million dollars under Section 64 of Public Act 108 of 1985, to move homes along the Great Lakes Shoreline that were in imminent danger of destruction. The program was designed to be as quick and responsive as possible.

Eligibility included the following:

1. Proximity of the structure to the active edge of erosion, generally 35 feet or less.
2. Slope of the bluff face.
3. Height of the bluff.
4. Composition of the bluff material.
5. Presence, condition and effectiveness of existing shore protection structures.

Applicants reportedly received notification of eligibility within two weeks. The deadline for applications was August 1986. Final payments were made in March 1987. 273 applications were received, of which 199 were determined eligible for the program. Sixty-four applicants took action and collected subsidies for relocation. Eight others were for shore protection. The subsidies provided were for low interest loans with a 3% interest rate on loans of up to \$25,000. The subsidies totaled an outlay of \$267,000. (Duckworth, 1999)

Wisconsin's state emergency management plan does not deal with flooding or shoreline erosion. It provides guidelines on how to deal with various hazard situations. (Wigle, 2000). The Wisconsin Natural Hazards Coastal Program put together a recession study of the lakefront to project where erosion will likely occur. Portions of the coast were mapped in a pilot project to determine recession rates. It is uncertain how soon Wisconsin will complete mapping of the entire coast.

Indiana has an emergency management plan, but it does not include shoreline flooding or erosion as hazards to consider in state or local emergency management planning (Stanley, 2000).

The State of Illinois has a special agency for this purpose. It is the Illinois Emergency Management Agency (IEMA). IEMA deals with non-law enforcement emergencies. They do mitigation and planning for flooding, but do not deal with shoreline hazards. The plan deals with specific opportunities for local governments to get involved with floodplain ordinances, improving regulation and improving ordinance enforcement.

4.2.2 County Disaster Planning

Of the five pilot counties in the 1999 Study area:

- Ottawa County, Michigan: Erosion and flooding are not dealt with in the county hazard management plan (Smith, 1999).
- Allegan County, Michigan: Erosion and flooding are not dealt with in the county hazard management plan (Brunett, 1999).
- Ozaukee County, Wisconsin: Shoreline erosion in plan developed by Wisconsin Natural Hazards Coastal Program, flooding mitigation limited to zoning of coastal and floodplain areas for protection from hazards (Verhagan, 1999).
- Manitowoc County, Wisconsin: Flooding in plan, they rely on zoning of coastal and floodplain areas for protection from hazards.
- Sheboygan County, Wisconsin: No plan, they rely on zoning of coastal and floodplain areas for protection from hazards.

The few shoreline counties in Indiana and Illinois were contacted for information on hazard management:

- LaPorte, Indiana: The County did not reply to repeated requests for information.
- Lake, Indiana: There is no plan to mitigate for erosion or flooding, only what to do after a flood.
- Porter, Indiana: There is no plan to mitigate for erosion or flooding, only what to do after a flood (Stevens, 1999).
- Lake, Illinois: Illinois Emergency Management Agency (IEMA) Region 4 handles emergency management for the two-county coastal area of Illinois (Cook and Lake Counties). There is no plan to deal with hazards of erosion or flooding but the county experiences considerable erosion in its high bluff area (Schultz, 1999).
- Cook, Illinois: The county has both shoreline erosion and flooding mitigation in their plan. They have noted "special flood hazard areas" in their zoning ordinance to limit further development in the hazardous shoreline areas (Moriarty, 1999).

4.3 Extent of Application

Flood protection efforts were described as minimal in the 1993 IJC Report and that is largely true in 1999. According to FEMA lists, there are 171 coastal communities within the four Lake Michigan states (Illinois, 16; Indiana, 15; Michigan, 102 and Wisconsin, 38) participating in the National Flood Insurance Program (NFIP). In addition, 5 communities have had flooding hazard areas identified but they are not in the NFIP (Illinois, 1; Indiana, 1; Michigan 3 and Wisconsin, 1).

It has been argued that having flood insurance available (such as in the 171 Lake Michigan communities) can serve to encourage development in hazard areas (Burby, 1998). This is because, although mitigation efforts may be required, these efforts may not be sufficient to avoid damage from future disasters. However, it could be argued that in the five Lake Michigan communities identified as having flood hazard areas but not participating in the NFIP, development may be limited within flooding hazard areas as it would be difficult to obtain flood insurance and thus a mortgage. It is uncertain if those flood hazard areas face development. The communities may have chosen not to participate because the identified areas are already preserved or are otherwise undevelopable.

4.4 Effectiveness

There has been some awareness building about flood mitigation among the four states. In Indiana and Illinois this may be focused primarily on the Mississippi River basin and less on the Lake Michigan estuaries. However, George Hosek of the MDEQ reports increased interest in flood levels and the NFIP. The primary interest is in the specific areas that have experienced flooding, such as in numerous southeastern Michigan communities where flooding has resulted in sewer back-ups into homes. In other communities, there is less sense of urgency among property owners. Milwaukee, Wisconsin experienced flooding that closed the water treatment plant, raising human health concerns, but the cause was attributed to high river levels, not a high Lake Michigan. Unless communities pay heed to potential extreme high Lake Michigan levels, such occurrences could be repeated.

The drowned river mouth lake is typical of Michigan, not Wisconsin, Indiana or Illinois. Such a lake provides expanded opportunities for development along the river shoreline, due to the widening of the stream and often, the floodplain. A few of those have homes built in the floodplain and property owners have experienced flooding at high Lake Michigan levels. Lower Herring Lake, in Benzie County is an example, where there is only a 3' check dam.

Flood proofing regulations remain tied to 100 year flood elevations. This could be a problem if Lake Michigan levels exceed the 100 year elevation, and this is possible. For example, Commonwealth Edison, a power company in Illinois, only

considered the 100 year Lake Michigan elevation in planning their Nuclear facility in Waukegan, which closed in 1998 (Michaud, 1999).

There appears to be an increased pressure to obtain building permits for sites within floodplains during periods of low Lake Michigan levels (Planning officials during focus groups, 1999). Where local units of government grant such applications as variances to existing floodplain regulations, this places an increased amount of property at risk. Further, communities without floodplain regulations are more likely to grant building permits on hazard sites, again during periods of low Lake Michigan levels.

4.5 Compatibility/Indirect Benefits

The 1993 IJC Report identifies indirect benefits of flood loss reduction but potential negative effects on drainage from fill, soil compaction from construction equipment to complete mitigation projects and visual impairment from a proliferation of houses on stilts.

The greatest benefits of reducing flood loss and protecting the environment and visual quality would occur if structures in flood hazard areas were removed to higher ground. While some level of indirect benefits would accrue from flood proofing and elevating structures or removing structures consistent with the 100-year flood elevation, the experience of the 1993 Mississippi River flooding suggests mitigation measures tied to 500-year flood elevations will have the greatest benefits. It is unknown how many structures would be affected within the 500-year floodplain.

4.6 Implementability

The 1993 IJC Report points out that flood mitigation efforts have been better received in Canada than the United States. The 1993 IJC Report also states that not all structures can be elevated and raising structures does not apply to areas that both flood and experience coastal erosion that undermines footings. Another factor affecting implementation is the resistance of many homeowners to move--either because of the water view, emotional attachment to the place or a lack of parcel depth. Further, the costs to elevate or move a structure may not be within reach of many living in flood hazard areas, requiring assistance to fully implement.

5.0 LAND ACQUISITION PROGRAMS AND PUBLIC INVESTMENT

5.1 Overview

Public acquisition of shoreline property to prevent development in hazard areas was discussed in the 1993 IJC Report. It can be a very direct approach to limiting development and thus economic damage, but the policy of limiting development through public acquisition has been directed more at farmland and unique features or habitat preservation and less toward hazard reduction in the Great Lakes states. In addition to land acquisition as a public investment, this 1999 update also looks at how public entities plan infrastructure investment along the shoreline. There can be substantial economic risk to publicly owned infrastructure along the coast. Do agencies limit such investment to low-investment facilities such as open space? Do they adequately plan for natural shoreline processes and at what lake elevations do they plan?

Public land acquisition can be purposeful or it can be accidental. Purposeful acquisition is programmed by goal setting, such as a goal to provide public access to the Great Lakes or transportation along or to the shoreline. Accidental acquisition usually occurs through gifting of land from private owners or through reversion of tax delinquent properties.

5.2 Extent of Application

Purchases under the Acquisition Flood Damage Program, National Flood Insurance Program, FEMA, have been non-existent on the Lake Michigan shoreline.

The states, local governments and regional non-profit land conservancies have acquired properties on both the Lake Michigan shoreline and its estuaries. However, no master lists are kept of these acquisitions. They have also been targeted to undeveloped shoreline areas.

5.3 Effectiveness

As explained in the 1993 IJC Report, land acquisitions (with the intent of preventing development or removing structures from hazard zones) can be highly effective for the properties purchased. While the 1993 IJC Report states that strategic purchase of adjacent, highest risk properties is the most effective, that has hardly been the experience. Acquisition is very scattered and not for the purpose of removing structures from hazard zones.

5.3.1 Cost of Measure

Costs were not investigated for this update.

5.3.2 Net Benefits

As in the 1993 IJC Report, a suitable data base and methodology does not yet exist for this analysis.

5.4 Compatibility/Indirect Effects

Acquisition programs have a strong, positive effect on the natural environment and on damage reduction, as stated in the 1993 IJC Report.

5.5 Implementability

Costs remain an obstacle, both for acquisition and for long-term administration of acquired property. There can be financial benefits to private property owners for donations of such lands, but this remains an infrequent occurrence.

5.6 Tax Reversion

In addition to the discussion provided in the 1993 IJC Report, it should be noted that in Michigan, Wisconsin, Indiana and Illinois, lands on which property taxes are not paid become the property of the state and can be transferred to local units of government. Michigan appears to be the only state of the four in which tax reverted land goes to the DNR. DNR staff in the other states do not know what becomes of the land. While some communities have welcomed the opportunity to obtain this land for open space, many also prefer the land to remain in private ownership for property tax and economic development reasons. There tends to be no consistency, in that a particular unit of government may, at one time, want the land for open space and at another time, decide differently. A part of this variation could be accounted for by changing values of the different sets of elected officials over time.

Michigan, Wisconsin, Indiana and Illinois do not maintain data bases that can adequately determine where there have been tax reverted waterfront parcels.

The number of waterfront parcels to become tax reverted may be small because there is often a ready market for such land.

5.7 Michigan CMI Waterfront Development Program

The Clean Michigan Initiative, passed by Michigan voters in 1998, allocated \$50 million to waterfront improvement grants. The purpose of these grants was to help purchase waterfront brownfield parcels and clean them for use for future economic development. As of the end of 1999, the program was processing applications for this one-time grant, and acreages of acquired lands were not known. There is the potential that acquired sites would include those with flood hazards at or greater than 100-year storms. This program seeks to foster

waterfront development, not open space. Thus, there is a high likelihood for re-use of hazard areas with eventual economic damages.

6.0 STRUCTURAL SHORE PROTECTION (FLOODING)

6.1 Overview

Flooding of lakeshore property can arise from high lake levels or wind set-up. Few areas directly on Lake Michigan are prone to flooding. The problem primarily affects drowned lake mouths and estuaries of Lake Michigan. These include Lake Macatawa, Kalamazoo Lake, Spring Lake and others. Estuary and creek floodplains not associated with drowned lakes can also experience flooding if Lake Michigan rises to an extreme high level.

An inventory of shore protection structures along estuaries is essential to an analysis of shore protection trends. This was not completed for estuaries as part of the 1999 study.

Diking is the primary structural approach to flood protection. This study did not find any report of dike construction within the study area in the past decade.

7.0 STRUCTURAL SHORE PROTECTION (EROSION)

7.1 Overview

Shore protection structures attempt to limit the loss of shore land to the erosive action of the lake. Structures include seawalls, revetments, groins, breakwalls and others and the terms are defined in Section 1.3.

The 1993 IJC Report found that, according to a riparian survey, 33% of US riparians have reinforced their shores with protection structures. For the 1999 study, an inventory of shoreline protection structures was conducted through an analysis of aerial photographs taken at different years.

The 1999 inventory of shoreline protection structures was conducted by Orca Technologies and their full report, including data and maps is the best source of information on shore protection structures. A short commentary on trends found in the data, as interpreted by Planning & Zoning Center, Inc. follows.

Shore protection structures were inventoried to determine the extent of shore protection and to identify trends. In Michigan, Allegan and Ottawa County were inventoried, using 1989 and 1999 air photographs. In Wisconsin, Manitowoc, Ozaukee and Sheboygan Counties were inventoried, using 1978 and 1992 air photographs. The inventory was mapped and assembled as data by Orca Technologies in 1999. The percent change was calculated by Orca Technologies. Table 4 aggregates this data by County for all shore protection types. Based on the rate of change Orca found by interpreting aerial photographs, straight-line projections to 2050 were made by Planning & Zoning Center, Inc. The base data and projections by County are presented on Table 5.

All counties studied showed an increase in structural shore protection for the period represented by the two sets of aerial photographs. There was a 5% increase for all Wisconsin counties over a fifteen-year period of 1978 to 1992. In Allegan County, Michigan there was a 5% increase over a ten-year period of 1989 to 1999, a more rapid rate of increase. Ottawa County, Michigan had less than one percent increase in length of structural shoreline protection over the same ten years.

The shoreline inventory classified shore protection structures according to type of structure and estimated lifespan. Types of structures included seawalls, revetments, breakwaters, groins and ad hoc protection. This latter category could include dumping old tires or broken concrete on the bluff in an attempt armor the bluff from erosive forces of waves and wind. The lifespan classifications were: greater than 45 years expected life, 5-45 years expected life, less than 5 years and 0 years. These latter structures were in a deteriorated condition. The category of 5-45 years expected life is important because all of those structures will either fail or require replacement within the 50 year planning horizon. Within

Table 4
SUMMARY OF PERCENT CHANGE AND TOTAL LENGTH OF SHORE PROTECTION STRUCTURES IN PILOT COUNTIES BY STRUCTURE LIFESPAN

Structure Lifespan	Michigan (1989-1999)				Wisconsin (1978-1992)						Total Length in Meters in 5 Counties
	Allegan County		Ottawa County		Manitowoc County		Ozaukee County		Sheboygan County		
	Percent Change from Base Year	Length in Meters After Change	Percent Change from Base Year	Length in Meters After Change	Percent Change from Base Year	Length in Meters After Change	Percent Change from Base Year	Length in Meters After Change	Percent Change from Base Year	Length in Meters After Change	
All 45+ year structures	0.00%	1,000	1.22%	800	2.55%	10,435	2.40%	9,310	1.88%	3,345	24,890
All 5-45 year structures	496.00%	5,975	1.54%	9,120	2.71%	3,410	5.11%	8,025	3.52%	4,697	31,227
All < 5 year structures	7.50%	1,900	-1.24%	1,055	0.11%	970	-1.15%	5,470	0.23%	2,130	11,525

Data Source: Orca Technologies. Summary by Planning & Zoning Center, Inc.

Table 5a
ALLEGAN COUNTY, MICHIGAN SUMMARY SHORELINE STRUCTURAL PROTECTION STATISTICS PROJECTED TO 2050

Shore Protection Type	89 LENGTH (M)	% COUNTY	99 LENGTH (M)	% COUNTY	CHG (M)	CHG (%)	Proj 2010 LENGTH (M)	Proj 2020 LENGTH (M)	Proj 2050 LENGTH (M)	% CHANGE 1999-2050
1A1 - Revetments>45 Year Lifespan	750	1.88	750	1.88	0	0.00	750	750	750	0%
1A2 - Revetments 5-45 Year Lifespan	485	1.21	1,065	2.66	580	1.45	1,703	2,283	4,023	74%
1A3 - Revetments 0-5 Year Lifespan	765	1.91	65	0.16	-700	-1.75	0	0	0	
1A4 - Revetments 0 Year Lifespan (Disrepair)	0	0.00	75	0.19	75	0.19	0	0	0	0%
1B2 - Seawalls/Bulkheads 5-45 Year Lifespan	1,570	3.93	2,445	6.11	875	2.19	3,408	4,283	6,908	65%
1B3 - Seawalls/Bulkheads 0-5 Year Lifespan	350	.088	0	0.00	-350	-0.88	0	0	0	
1B4 - Seawall/Bulkhead 0 Year Lifespan (Disrepair)	0	0.00	75	0.19	75	0.19	0	0	0	0%
2A2 - Groins 5-45 Year Lifespan	1,375	3.44	1,855	4.64	480	1.20	2,383	2,863	4,303	57%
2A4 - Groins 0 Year Lifespan (Disrepair)	0	0.00	35	0.09	35	0.09	0	0	0	0%
2B1 - Jetties	100	0.25	100	0.25	0	0.00	100	100	100	0%
3C1 - Slope/Bluff Stabilization >45 Year Lifespan	250	0.63	250	0.63	0	0.00	250	250	250	0%
3C2 - Slope/Bluff Stabilization 5-45 Year Lifespan	0	0.00	400	1.00	400	1.00	840	1,240	2,440	84%
5A2 - Ad Hoc, Concrete Rubble 5-45 Year Lifespan	210	0.53	210	0.53	0	0.00	210	210	210	0%
5A3 - Ad Hoc, Concrete Rubble 0-5 Year Lifespan	200	0.50	100	0.25	-100	-0.25	-10	0	0	0%
5A4 - Ad Hoc, Concrete Rubble 0 Year Lifespan (Disrepair)	315	0.79	885	2.21	570	1.43	0	0	0	0%
5B2 - Ad Hoc, Other Materials, 5-45 Year Lifespan	350	0.88	0	0.00	-350	-0.88	0	0	0	0%
5B3 - Ad Hoc, Other Materials, 0-5 Year Lifespan	300	0.75	600	1.50	300	0.75	930	1,230	2,130	72%
5B4 - Ad Hoc, Other Materials, 0 Year Lifespan (Disrepair)	0	0.00	65	0.16	65	0.16	0	0	0	0%
Total Protected Shoreline	7,020	18	8,975	22	1,955	5	10,564	13,209	21,114	57%
7 - Unprotected	33,170	82.93	31,550	78.88	-1,620	-4.05	29,768	28,148	23,288	-35%

Note: Percentages are of 46km length for entire county, but straight line projections by Planning & Zoning Center, Inc., based on 1989-1999, may result in lengths greater than there is shoreline.

Quick Analysis: 1.6km of New Shore Protection in 10 Years. Higher use of Ad Hoc Materials than Ottawa County. Almost 0.5 km addition of groyness...Holmberg Tubes? 0.8 km of seawalls added, plus reduction in lower quality walls: replacement?

Table 5b

OTTAWA COUNTY, MICHIGAN SUMMARY SHORELINE STRUCTURAL PROTECTION STATISTICS PROJECTED TO 2050

Shore Protection Type	89 LENGTH (M)	% COUNTY	99 LENGTH (M)	% COUNTY	CHG (M)	CHG (%)	Proj 2010 LENGTH (M)	Proj 2020 LENGTH (M)	Proj 2050 LENGTH (M)	% CHANGE 1999-2050
1A1 - Revetments>45 Year Lifespan	300	0.73	800	1.95	500	1.22	1,350	1,850	3,350	76%
1A2 - Revetments 5-45 Year Lifespan	375	0.91	515	1.26	140	0.34	669	809	1,229	58%
1B2 - Seawalls/Bulkheads 5-45 Year Lifespan	1,527	3.72	2,270	5.54	743	1.81	3,087	3,830	6,059	63%
1B3 - Seawalls/Bulkheads 0-5 Year Lifespan	1,425	3.45	915	2.23	-500	-1.22	365	0	0	0%
2A2 - Groins 5-45 Year Lifespan	6,585	16.06	6,335	15.45	-250	-0.61	6,060	5,810	5,060	-25%
2A3 - Groins 0-5 Year Lifespan	1,375	3.35	425	1.04	-950	-2.32	0	0	0	0%
2A4 - Groins 0 Year Lifespan (Disrepair)	140	0.34	140	0.34	0	0.00	0	0	0	0%
2B1 - Jetties	744	1.81	744	1.81	0	0.00	744	744	744	0%
3A2 - Beach Nourishment	1,100	2.68	1,600	3.90	500	1.22	2,150	2,650	4,150	61%
5B4 - Ad Hoc, Other Materials, 0 Year Lifespan (Disrepair)	10	0.02	0	0.00	-10	-0.02	0	0	0	0%
Total Protected Shoreline	13,571	33	13,744	34	173	0	14,425	15,693	20,592	33%
7 - Unprotected	30,152	73.54	29,561	72.10	-591	-1.44	28,911	28,320	26,547	-11%

Note: Percentages are of 46km length for entire county, but straight line projections by Planning & Zoning Center, Inc., based on 1989-1999, may result in lengths greater than there is shoreline.

Quick Analysis: 0.5km of New Shore Protection in 10 Years. (i.e., loss of 591 m of "unprotected")

Addition of 640 m of new revetments in 10 years...1.2% increase.

Loss of over 1 km of groins.

Increase in Beach Nourishment – Function of Snapshots in Time.

Table 5c

MANITOWOC COUNTY, MICHIGAN SUMMARY SHORELINE STRUCTURAL PROTECTION STATISTICS PROJECTED TO 2050

Shore Protection Type	78 LENGTH (M)	% COUNTY	92 LENGTH (M)	% COUNTY	CHG (M)	CHG (%)	Proj 2000 LENGTH (M)	Proj 2010 LENGTH (M)	Proj 2020 LENGTH (M)	Proj 2050 LENGTH (M)	% CHANGE 1999-2050
1A1 - Revetments>45 Year Lifespan	7,880	13.82	9,335	16.38	1,455	2.55		10,111	11,081	12,051	14,961
1A2 - Revetments 5-45 Year Lifespan	1,485	2.61	2,965	5.20	1,480	2.60	3,754	4,741	5,728	8,688	66%
1A3 - Revetments 0-5 Year Lifespan	285	0.50	570	1.00	285	0.50	722	912	1,102	1,672	66%
1A4 - Revetments 0 Year Lifespan (Disrepair)	45	0.08	0	0.00	-45	-0.08	0	0	0	0	0%
1B1 - Seawalls/Bulkheads >45 Year Lifespan	30	0.05	30	0.05	0	0.00	30	30	30	30	0%
1B2 - Seawalls/Bulkheads 5-45 Year Lifespan	45	0.08	110	0.19	65	0.11	145	188	231	361	70%
1B3 - Seawalls/Bulkheads 0-5 Year Lifespan	25	0.04	0	0.00	-25	-0.04	-13	-30	-47	-97	0%
2A2 - Groins 5-45 Year Lifespan	335	0.59	335	0.59	0	0.00	335	335	335	335	0%
2B1 - Jetties >45 Year Lifespan	1,070	1.88	1,070	1.88	0	0.00	1,070	1,070	1,070	1,070	0%
5A3 - Ad Hoc, Concrete 0-5 Year Lifespan	125	0.22	100	0.18	-25	-0.04	87	70	53	3	0%
5A4 - Ad Hoc, Concrete 0 Year Lifespan (Disrepair)	200	0.35	200	0.35	0	0.00	0	0	0	0	0%
5B4 - Ad Hoc, Other Materials, 0 Year Lifespan (Disrepair)	225	0.39	100	0.18	-125	-0.22	0	0	0	0	0%
Total Protected Shoreline	11,750	21	14,815	26	3,065	5	16,240	18,397	20,554	27,024	45%
7 - Unprotected	45,485	79.80	42,420	74.42	-3,065	-5.38	37,516	31,386	25,256	6,866	-518%

Note: Percentages are of 57km length for entire county, but straight line projections by Planning & Zoning Center, Inc., based on 1989-1999, may result in lengths greater than there is shoreline.

Quick Analysis: ~80% of county unprotected in 1978, 74% in 1992...armor rate of 218m per year. Where SP exists it is primarily revetment. >5% increase in construction/improvements to revetments.

Table 5d
OZAUKEE COUNTY, MICHIGAN SUMMARY SHORELINE STRUCTURAL PROTECTION STATISTICS
PROJECTED TO 2050

Shore Protection Type	78 LENGTH (M)	% COUNTY	92 LENGTH (M)	% COUNTY	CHG (M)	CHG (%)	Proj 2000 LENGTH (M)	Proj 2010 LENGTH (M)	Proj 2020 LENGTH (M)	Proj 2050 LENGTH (M)	% CHANGE 1999-2050
1A1 - Revetments>45 Year Lifespan	838	1.90	1,038	2.36	200	0.45	1,145	1,278	1,411	1,811	43%
1A2 - Revetments 5-45 Year Lifespan	1,120	2.55	2,450	5.57	1,330	3.02	3,159	4,046	4,933	7,593	68%
1A3 - Revetments 0-5 Year Lifespan	895	2.03	805	1.83	-90	-0.20	757	697	637	457	0%
1A4 - Revetments 0 Year Lifespan (Disrepair)	0	0.00	255	0.58	255	0.58	0	0	0	0	0%
1B1 - Seawalls/Bulkheads >45 Year Lifespan	1,682	3.82	2,107	4.79	425	0.97	2,334	2,617	2,900	3,750	44%
1B2 - Seawalls/Bulkheads 5-45 Year Lifespan	840	1.91	1,050	2.39	210	0.48	1,162	1,302	1,442	1,862	44%
1B3 - Seawalls/Bulkheads 0-5 Year Lifespan	230	0.52	260	0.59	30	0.07	276	296	316	376	0%
2A2 - Groins 5-45 Year Lifespan	150	0.34	0	0.00	-150	-0.34	-80	-180	-280	-580	0%
2B1 - Jetties	200	0.45	200	0.45	0	0.00	200	200	200	200	0%
2C1 - Offshore Breakwaters, >45 Year Lifespan	0	0.00	200	0.45	200	0.45	307	440	573	973	79%
5A2 - Ad Hoc, Concrete, 5-45 Year Lifespan	457	1.04	437	0.99	-20	-0.05	426	413	400	360	-22%
5A3 - Ad Hoc, Concrete 0-5 Year Lifespan	580	1.32	760	1.73	180	0.41	856	976	1,096	1,456	48%
5A4 - Ad Hoc, Concrete 0 Year Lifespan (Disrepair)	325	-.84	25	0.06	-300	-0.68	0	0	0	0	0%
5B2 - Ad Hoc, Other Materials, 5-45 Year Lifespan	30	0.07	30	0.07	0	0.00	30	30	30	30	0%
5B4 - Ad Hoc, Other Materials, 0 Year Lifespan (Disrepair)	0	0.00	25	0.06	25	0.06	0	0	0	0	0%
Total Protected Shoreline	7,347	17	9,642	22	2,295	5	10,572	12,115	13,658	18,288	47%
7 - Unprotected	37,153	84.44	35,168	79.93	-1,985	-4.51	31,992	28,022	24,052	12,142	-190%

Note: Percentages expressed as a percentage of 44km length for entire county.

Quick Analysis: Almost 2 km of New Shore Protection Added. 1.3km of 1A2 Revetment Added. Next biggest addition is 425m of seawall.

Note: Projections are straight line by Planning & Zoning Center, Inc. based on 1989-1999 change and results in lengths greater than there is shoreline.

Table 5e

SHEBOYGAN COUNTY, MICHIGAN SUMMARY SHORELINE STRUCTURAL PROTECTION STATISTICS PROJECTED TO 2050

Shore Protection Type	78 LENGTH (M)	% COUNTY	92 LENGTH (M)	% COUNTY	CHG (M)	CHG (%)	Proj 2010 LENGTH (M)	Proj 2010 LENGTH (M)	Proj 2020 LENGTH (M)	Proj 2050 LENGTH (M)	% CHANGE 1999-2050
1A1 - Revetments>45 Year Lifespan	3,290	7.15	5,440	11.83	2,150	4.67	6,587	8,020	9,453	13,753	60%
1A2 - Revetments 5-45 Year Lifespan	4,235	9.21	5,895	12.82	1,660	3.61	6,780	7,887	8,994	12,314	52%
1A3 - Revetments 0-5 Year Lifespan	3,140	6.83	2,070	4.50	-1,070	-2.33	1,499	786	73	-2,067	0%
1A4 - Revetments 0 Year Lifespan (Disrepair)	255	0.55	0	0.00	-255	-0.55	0	0	0	0	0%
1B1 - Seawalls/Bulkheads >45 Year Lifespan	3,000	6.52	3,320	7.22	320	0.70	3,491	3,704	3,917	4,557	27%
1B2 - Seawalls/Bulkheads 5-45 Year Lifespan	1,125	2.45	1,050	2.28	-75	-0.16	1,010	960	910	760	-38%
1B3 - Seawalls/Bulkheads 0-5 Year Lifespan	725	1.58	310	0.67	-415	-0.90	89	-188	-465	-1,295	0%
1B4 - Seawalls/Bulkheads 0 Year Lifespan (Disrepair)	0	0.00	75	0.16	75	0.16	0	0	0	0	0%
2A1 - Groins >45 Year Lifespan	1,600	3.48	0	0.00	-1,600	-3.48	-853	-1,920	-2,987	-6,187	0%
2A2 - Groins 5-45 Year Lifespan	275	0.60	400	0.87	125	0.27	467	550	633	883	55%
2A3 - Groins 0-5 Year Lifespan	0	0.00	1,475	3.21	1,475	3.21	2,262	3,245	4,228	7,178	0%
2B1 - Jetties >45 Year Lifespan	315	0.68	300	0.65	-15	-0.03	292	282	272	242	-24%
2C1 - Offshore Breakwaters, >45 Year Lifespan	0	0.00	250	0.54	250	0.54	383	550	717	1,217	79%
5A2 - Ad Hoc, Concrete, 5-45 Year Lifespan	40	0.09	680	1.48	640	1.39	1,021	1,448	1,875	3,155	78%
5A3 - Ad Hoc, Concrete 0-5 Year Lifespan	595	1.29	245	0.53	-350	-0.76	58	-175	-408	-1,108	0%
5A4 - Ad Hoc, Concrete 0 Year Lifespan (Disrepair)	1,250	2.72	1,295	2.82	45	0.10	0	0	0	0	0%
5B3 - Ad Hoc, Other Materials, 0-5 Year Lifespan	35	0.08	0	0.00	-35	-0.08	-19	-42	-65	-135	0%
Total Protected Shoreline	19,880	43	22,805	50	2,925	6	23,067	25,107	27,147	33,267	31%
7 - Unprotected	27,720	60.26	25,595	55.64	-2,125	-4.62	22,195	17,945	13,695	945	-2608%

Note: Percentages are of 46 km length for entire county, but straight line projections by Planning & Zoning Center, Inc. based on 1989, may result in lengths greater than there is shoreline.

Quick Analysis: Largest range in quality for structures found. Changes in Groins due to deterioration of one large group. Revetments and Seawalls Predominate. 27.7km unprotected in 1978...25.5 unprotected in 1992...loss of 152m per year.

the five county study area, this accounts for about 31 kilometers of shoreline out of a total of 239 kilometers of shoreline. Only about 24 kilometers of shoreline is protected by structures estimated to survive greater than 45 years, or nearly the entire 50 year period. Nearly 12 kilometers are protected by structures with 0 to 5 years lifespan. These already require replacement or will need extensive repair or replacement by 2004.

If the rates of increase in structural shoreline protection were to continue to the year 2050, nearly half of the Wisconsin and Michigan shorelines in the study counties will have some form of structural shore protection. For this to happen, several assumptions would have to come true:

- Property owners of the segments of shoreline without structural protection at the time the aerial photographs were taken would have to decide that structural protection fulfilled a need to protect land or primary structure above the bluffs. There are many factors that will influence that decision: imminent threat to primary structures, water levels, past loss of land to bluff recession, level of investment in the property, structural protection on adjoining properties, cost of structural protection and others. It should be remembered that not all portions of the Lake Michigan shoreline experiences rapid rates of recession.
- Regulatory agencies would have to continue permitting the installation of structural protection at the same rates as between the years of the aerial photographs used in the inventory.
- None of the existing protection structures would fail or those that did would be replaced in addition to construction of new structures according to the trends.

By 2050, if recent trends continue, it is projected that the following lengths of Lake Michigan shoreline in the study counties will have structural shore protection:

• Manitowoc County, Wisconsin	27 km of 56 km by 2050
• Ozaukee County, Wisconsin	18 km of 44 km by 2050
• Sheboygan County, Wisconsin	33 km of 46 km by 2050
• Allegan County, Michigan	21 km of 46 km by 2050
• Ottawa County, Michigan	20.6 km of 46 km by 2050
• <i>Total Five Counties</i>	<i>119.6 km of 239 km by 2050</i>

The figures above include all expected construction type and lifespan categories of shoreline protection. When these projections were made, structural shore protection categories estimated to have a lifespan of 0 years were not projected into the future, on the assumption that they would not survive. Of course, these may be the ones to be replaced in the greatest number, or because they have failed, the shoreline owners may give up on shore protection. Without a parcel specific survey, it is difficult to conjecture.

In terms of costs to protect property from shoreline damages, there will likely be a large expenditure for replacement of existing structures one or more times. This

is due to the demise of structures with a lifespan of less than 50 years, that are not singled out from the projections. There is not enough information to speculate on when replacements would take place or the degree to which replacements would be of a quality that would have a longer lifespan. However, the following observations are apparent:

- Seawalls and groins are the predominate structural protection approach in Allegan and Ottawa Counties in Michigan.
- Revetments and seawalls predominate in Manitowoc, Ozaukee and Sheboygan counties in Wisconsin.

Some difference in structural protection approaches between Michigan and Wisconsin can be expected due to different physiographic conditions or bluff composition and wave action as well as local understanding, preferences and permitting history. Speculation, based on focus group comments and other discussions suggests that the greater use of groins in Michigan may be due, in part to the aggressive marketing of the Holmburg Tube, a fabric, sand or concrete-filled tube used as a groin.

The inventory may include some doubling of shore protection length where breakwaters were located. Since these are an offshore structure, there could also be structural protection of other types, such as revetments or seawalls, constructed on the shore and parallel to the breakwater.

8.0 NON-STRUCTURAL SHORE PROTECTION

8.1 Overview

Non-structural shore protection measures consist of a variety of methods to afford protection or stabilization of the shoreline. Methods include beach nourishment or shoreline stabilization using vegetation to stabilize bluffs and to build and maintain protective sand dunes.

Non-structural shoreline protection measures were not studied as part of this 1999 Report on land use management measures.

The issue of non-structural approaches is important. Sand transport on, off, and along the shoreline dramatically affects the form of the shore and the rate at which it changes. A rapidly changing shoreline, especially one that recedes, has profound land use implications.

Beach nourishment is sought where the beach rapidly erodes due to either natural or man-induced sand transport processes. If the process accelerates due to man-made structures, such as groins or jetties, being constructed on nearby properties or harbors, the question of liability arises. If the process is natural, it raises the question of how much effort and expense should the community expend to maintain beach protection of erodible bluffs.

Vegetative cover has been advocated for several decades by the Departments of Natural Resources of Great Lakes and sea coast states. While vegetative cover helps hold dunes that may protect structures on the land in the event of extreme high waters and waves, its greatest asset is in helping to minimize wind erosion. Vegetative shore protection helps slow the rate of shoreline loss, but it should not be expected to prevent bluff erosion when Lake Michigan levels are at extreme highs.

9.0 SHORELINE ALTERATION REQUIREMENTS/SHORELINE LEGISLATION (STATE LEVEL)

9.1 Overview

In order to provide protection to public shoreline resources, private property and the health and safety of citizens, states enact legislation to deal with shoreline hazards. State regulations can provide consistency across local boundaries. They can also provide legal and/or administrative support for local units to regulate, when political will is lacking at the local level.

The following discussion looks at state shoreline legislation of the four Lake Michigan states. All significant laws and administrative regulations are summarized (even though some of the laws principally apply to property on inland waters).

9.2 State Legislation

Michigan

The key state statute providing public protection from the natural hazards of coastal erosion and flooding as well as environmental protection of fragile coastal areas is Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, PA 451 of 1994. Part 323 is closely integrated with Part 325, the Great Lakes Submerged Lands program and the Coastal Management Program, which includes Part 353, Sand Dunes Management, as well as grants to state and local units of government.

There are three coastal issue areas under Part 323:

1. **High Risk Erosion Areas.** The Michigan Department of Environmental Quality (MDEQ) has mapped about 300 miles of Michigan Great Lakes shoreline where active recession has been occurring at a long-term average rate of one foot or more a year. Regulations require setback distances to protect new structures for a period of 30 to 60 years. Local governments may adopt zoning regulations for high risk erosion areas, which if approved, replaces the need for a state high risk erosion area permit. As of 1999, there are 3 Michigan communities with approved high risk erosion area ordinances. Perhaps as many as several dozen have some limited protection provisions in place that have not been approved by the MDEQ and which apply in addition to MDEQ requirements.
2. **Flood Risk Areas.** Approximately 300 miles of Great Lakes mainland is subject to coastal flooding. The state requires new construction in the 100-year floodplain of the Great Lakes to be elevated to prevent property damage. Fifty-one coastal communities have designated and mapped flood risk areas and have flood regulations in effect. These communities have state-approved regulations and administer them locally. There are other communities which also apply floodplain regulations but which have not sought MDEQ approval.

3. Environmental Areas. Approximately 275 linear miles of essential habitat exists along Michigan's Great Lakes shorelands. Part 323 of PA 451 of 1994 provides for the designation of environmental areas up to 1,000' landward of the ordinary high water mark of a Great Lake or landward of the ordinary high water mark of lands adjacent to waters affected by levels of the Great Lakes. The Environmental Areas program sets up a review program where affected property owners must make application to the DEQ for any dredging, filling, grading or other alteration of the soil, natural drainage or vegetation or placement of permanent structures.

Great Lakes Shorelands Administrative Rules

The Administrative Rules for the Michigan Great Lakes Shorelands programs provide particular guidelines for administering the law (Part 323 of PA 451 of 1994). These include but are not limited to:

- Definitions:
 - Erosion hazard line - the line along the shoreland that is the landward edge of the zone of active erosion or the line where the 583.0 feet International Great lakes Datum contour meets the shoreland, whichever is furthest landward.
 - High bluff - a bluff or dune that is more than 25 feet in height measured from the appropriate elevation contour set forth in the definition of erosion hazard line.
 - Low bluff - bluff or dune that is 25 feet or less in height measured from the appropriate elevation contour set forth in the definition of erosion hazard line.
- Requirement of a permit to erect, install, move or enlarge a permanent structure on a parcel, any portion of which is in a designated high-risk erosion area.
- Criteria for movable structures. A readily movable structure is a small permanent structure which is designed, sited and constructed to provide for relocation at a reasonable cost (not more than 25% of the replacement cost). Access to the site and structure must be sufficient to permit relocation. Above-grade walls must be stud wall or whole log construction. Above-grade walls of masonry, poured concrete or concrete block do not meet the requirements.
- Required setback distance. This is the least distance a permanent structure can be constructed from the erosion hazard line without a special exception.
 - For low bluffs the required setback distance is at the projected recession distance from the erosion hazard line.
 - For high bluffs, the required setback distance is calculated by adding 1.0 to the product of the percentage points of slope over 25% and 0.05 to a maximum of 2.0. For example, if the slope is 40%, the setback distance is multiplied by 1.75 (1.0 plus 0.75, derived from the percent slope over 25%, or 15, times 0.05). If the setback distance is 100' and the slope of the high bluff is 40%, then the required setback is 175'.

- For bluffs and dunes with slopes of more than 60% and are more than 100' high, the required setback distance is at least 30' from the lakeward facing slope of the dune or bluff.
- The setback line is based on a recession distance of 30 years times the average annual recession rate for small structures and 60 years times the annual recession rate for large structures.
- Substandard parcels. Some properties may be created without sufficient depth landward of the setback line to site a permanent structure. These parcels may have been created when the land was subdivided or they may have been sufficiently large enough structures when platted but bluff recession has substantially reduced the size of the parcel.
- Shore protection structures.
 - If site conditions prohibit a movable structure or the planned structure is large on a substandard parcel, permission may be granted to use shore protection in lieu of a portion of the setback. However, the following provisions must be met:
 - If an on-site septic system is used, it must be located at least as far landward as the permanent structure.
 - The structure must be sited as far landward as local zoning permits and landward of the erosion hazard line.
 - The shore protection structure must be engineered to withstand 20 to 50 year storm events, depending on the size of the permanent structure above the bluff.
 - The permanent structure must be a minimum of 30' from the shore protection structure.
 - Where the permanent structure is large, the following may be required:
 - Establishment of an escrow account for maintenance of the shore protection structure.
 - Notice in the disclosure statement or deed that a portion of the required setback has been waived.
 - Special exceptions may be granted or a portion of the setback waived for the installation of an approved shore protection project. However, certain conditions must be met. These include:
 - A contract for the long-term maintenance of the structure.
 - Design of the shore protection project to withstand a 50-year storm.
 - A favorable finding by the local agency with input by the DEQ that a greater public good exists to support the use of a shore protection structure rather than a natural shoreline in terms of fish and wildlife habitat, impact of the loss of sand movement, impact on erosion of nearby land and the comparative value to the community of additional development verses a natural shoreline.
- The Department of Environmental Quality is charged with updating recession rates every ten years.

Great Lakes Submerged Lands

The Michigan Department of Environmental Quality also administers programs related to construction on bottom lands of the Great Lakes and connecting waters that are influenced by changes in the Great Lakes. Bottomlands are defined by Administrative Rules to Part 325 of PA 451 of 1994 as "lands in the Great Lakes and bays and harbors thereof, lying below and lakeward of the ordinary high water mark." This program is concerned with protecting public trust interests of water quality in, and access to, the Great Lakes.

The Submerged Lands Program administers:

- Bottomland Conveyances. This program deals with commercial marinas, ferry or industrial loading docks and filled residential lots on Lake St. Clair.
- Marina Operating Permits. This program is authorized under Part 301 (Inland Lakes and Streams) of the Natural Resources and Environmental Protection Act, PA 451 of 1994. Marina operating permits are required to operate commercial (and those that serve multiple, non-commercial users) recreational structures, such as marina docks, ramps, boat hoists and rafts. A separate, construction permit is also required as a precursor to the operating permit. Obtaining one permit does not guarantee the other.
- Submerged Cultural Resources. This part of the program administers management of the estimated 2,000 shipwrecks on Michigan's Great Lakes bottomlands. Administration is in conjunction with the Michigan Historical Center, Department of State, as authorized by Part 761, Aboriginal Records and Antiquities of PA 451 of 1994.
- St. Clair Flats. Administration of private lease-holdings of certain bottomlands at the mouth of the St. Clair River is authorized under Part 339, Control of Certain State Lands, of PA 451. The program seeks to protect the natural resources of the area through maintenance of developed structures and sanitary facilities, while fairly dealing with long-time lease holders.

Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as Amended

The primary intent of Part 91 is to protect the waters of the state by minimizing erosion and controlling sediment.

A permit is required for any earth change that disturbs one or more acres, or is within 500 feet of a lake or stream. Exempted activities include plowing and tilling for crop production, logging and mining. However, access roads to the logging and mining operations are not exempt.

Counties have the primary responsibility for issuing permits. In some cases, cities, villages and charter townships have assumed permitting responsibility within their jurisdictions. Permit applications can be obtained from the respective county or local agencies.

The Soil Erosion and Sedimentation Control program promotes/mandates consideration of the following principles when developing a soil erosion and sedimentation control plan.

- Integrate the overall construction design and activities to fit the physical and vegetative features of the site.
- Stage construction and stabilization activities to minimize the area and duration of disturbance.
- Identify control measures that will minimize erosion.
- Identify controls that will prevent off-site sedimentation. Sediment control should not be used as a substitution for erosion control, but rather in conjunction with erosion control.
- Establish an inspection and maintenance schedule.

There are penalties for not complying with permit conditions or Part 91:

- It is a misdemeanor to conduct regulated earth changes without a permit or in violation of permit conditions.
- A person who owns land that is not in conformance with Part 91 is subject to a civil fine of up to \$500 per violation.
- A stop work order may be issued until compliance is obtained.
- The permitting agency can install or maintain control measures to bring a nonconforming site into compliance with Part 91 and bill the landowner for the costs incurred.

The Soil Erosion and Sedimentation Control Program provides technical assistance and training of enforcement officers to communities.

The State of Michigan's Floodplain Regulatory Authority, is found in Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended.

Part 31 requires that a permit be obtained prior to any alteration or occupation of the 100-year floodplain of a river, stream or drain.

The Floodplain Regulatory Authority deals with the floodplains of rivers, streams, or drains which have a drainage area that is 2 square miles or greater. A permit is not required from the MDEQ, under Part 31, for alterations within the floodplains of the Great Lakes, inland lakes, or watercourses which have a drainage area less than 2 square miles. However, reviews may still be necessary under other State statutes found in NREPA such as:

Part 301 (Inland Lakes and Streams), Part 303 (Wetlands Protection), Part 315 (Dam Safety) Part 323 (Shorelands Protection and Management) Part 325 (Great lakes Submerged Lands) Part 353 (Sand dune Protection and Management) or Part 91 (Soil Erosion and Sedimentation Control).

Generally, the administrative rules provide that:

- Construction and fill may be permitted in the portions of the floodplain that are not floodway, provided local ordinance and building standards are met.
- New residential construction is specifically prohibited in the floodway.
- The minimum standard for residential construction within the 100-year floodplain requires that the lowest floor (including basement) be elevated above the 100-year flood elevation. Some communities and counties, may have a higher standard relating to elevation requirements.
- Non-residential structures must have the lowest floor either elevated above the 100-year flood elevation or be designed to be floodproof.
- The floodplain permitting review process is done by the floodplain engineer responsible for that portion of the state. The boundary map which shows the district boundaries.

Floodplain Mapping

While the primary source of floodplain mapping in Michigan are the Flood Insurance Rate Maps (FIRMs), prepared by FEMA, for site specific questions, the Land & Water Management Division will provide an estimated 100-year flood elevation.

National Flood Insurance Program Coordination in Michigan

The National Flood Insurance Program (NFIP) makes flood insurance available in communities that agree to manage their floodplains in such a manner that additional flood prone structures are not built.

The National Flood Insurance Program Coordinator works with local units of government to assist them in meeting the NFIP requirements. This is carried out through a program of education, technical assistance, and oversight. In addition, assistance is provided to lenders, realtors, and insurance agents, as well as private citizens who have questions about flood insurance or floodplain management.

Michigan has seen significant growth in the number of individuals whose homes or businesses are protected by flood insurance. As of August 12, 1998, there were 26,374 flood insurance policies in the state, providing coverage in the amount of \$2,305,979,400. Also, since 1978, Michigan citizens with flood insurance have been paid over \$28,000,000 for flood losses. These payments have come from the flood insurance fund - not from taxpayers.

Part 301 of PA 451 of 1994, Inland Lakes and Streams

This program requires permit applications for projects that deal with bottomlands, bulkhead lines, impoundments, inland lakes or streams, marinas, seasonal structures and dredging or filling bottomland, construction, enlargement, extension, removal, or placement of a structure on bottomland; erection,

maintenance or operation of a marina; creation, enlargement, or diminishing an inland lake or stream; structurally interfering with the natural flow of an inland lake or stream; construction, dredging, extension, or enlargement an artificial canal, channel, ditch, lagoon, pond, lake, or similar waterway where the purpose is navigation or ultimate connection with an existing inland lake or stream, or where any part of the artificial waterway is located within 500 feet of the ordinary high-water mark of an existing inland lake or stream.

The administrative rules provide for exceptions for:

- Any fill or structure existing before April 1, 1966, in waters covered by former Act No. 291 of the Public Acts of 1965, and any fill or structures existing before January 9, 1973, in waters covered for the first time by former Act No. 346 of the Public Acts of 1972.
- A seasonal structure placed on bottomland to facilitate private noncommercial recreational use of the water if it does not unreasonably interfere with the use of the water by others entitled to use the water or interfere with water flow.
- Reasonable sanding of beaches to the existing water's edge by a riparian owner.
- Construction or maintenance of a private agricultural drain regardless of outlet.
- A waste collection or treatment facility that is approved for construction by the department of public health or ordered or approved by the DEQ.
- Construction and maintenance of minor drainage structures and facilities which are identified by rule promulgated by the DEQ pursuant to section 30110(1).
- Maintenance and improvement of all drains legally established or constructed prior to January 1, 1973, pursuant to the drain code of 1956, Act No. 40 of the Public Acts of 1956, being sections 280.1 to 280.630 of the Michigan Compiled Laws, except those legally established drains constituting mainstream portions of certain natural watercourses identified in rules promulgated by the DEQ under section 30110.
- Projects constructed under the watershed protection and flood prevention act, chapter 656, 68 Stat. 666, 16 U.S.C. 1001 to 1008 and 1010.
- Construction and maintenance of privately owned cooling or storage ponds used in connection with a public utility except at the interface with public waters.
- Maintenance of a structure constructed under a permit issued pursuant to this part and identified by rule promulgated under section 30110(1), if the maintenance is in place and in kind with no design or materials modification.

The DEQ shall issue a permit if it finds that the structure or project will not adversely affect the public trust or riparian rights. In passing upon an application, the DEQ shall consider the possible effects of the proposed action upon the inland lake or stream and upon waters from which or into which its waters flow and the uses of all such waters, including uses for recreation, fish and wildlife, aesthetics, local government, agriculture, commerce, and industry. The DEQ shall not grant a permit if the proposed project or structure will unlawfully impair

or destroy any of the waters or other natural resources of the state. This part does not modify the rights and responsibilities of any riparian owner to the use of his or her riparian water. A permit shall specify that a project completed in accordance with this part shall not cause unlawful pollution as defined by part 31.

The DEQ may establish by permit a bulkhead line on its own application or on the application of a local unit of government. The application shall be filed as provided in section 30104(1) with public notice and hearings as provided in section 30105. Upon acceptance of the bulkhead line by the affected units of government, the area landward of the bulkhead line shall after that acceptance be under the jurisdiction of those units of government as to the placement of structures and fills in the waters unless jurisdiction is returned to the state. In establishing a bulkhead line, the DEQ shall provide for local requirements and ensure the public trust in the adjacent waters against unreasonable interference.

Upon the written request of a riparian owner and upon payment of a service fee, the DEQ may enter into a written agreement with a riparian owner establishing the location of the ordinary high water mark for his or her property. In the absence of substantially changed conditions, the agreement shall be conclusive proof of the location in all matters between the state and the riparian owner and his or her successors in interest.

This part does not deprive a riparian owner of rights associated with his or her ownership of water frontage. A riparian owner, among other rights, controls any temporarily or periodically exposed bottomland to the water's edge, wherever it may be at any time, and holds the land secure against trespass in the same manner as his or her upland subject to the public trust to the ordinary high water mark.

Wisconsin

Shoreland Management Program:

Chapter NR 30 prohibits establishment of bulkhead lines, placing deposits or structures in navigable waters without a permit. This permit program applies to the placement of sand for recreational purposes, fish spawning structures, bird nesting structures, riprap or similar material to protect the bank from erosion, intake structures for water supply and other, similar changes to the bottom and banks of navigable waters.

Chapter NR 115, Administrative Rules, Department of Natural Resources

Section 59.971, Stats. and Section 114.26, Stats., requires counties to adopt zoning and subdivision regulations to further the maintenance of safe and healthful conditions, prevent and control water pollution; protect spawning grounds, fish and aquatic life; control building sites, placement of structure and land uses and reserve shore cover and natural beauty. These statutes establish a protection zone that includes lands within 1,000' of the ordinary high water mark of navigable waters, such as streams, rivers and lakes and 300' from a river

or stream or the landward side of the floodplain, whichever distance is greater. County zoning and subdivision regulations are required to include provisions for:

- Minimum lot size (10,000 square feet where served by public sewer and 20,000 square feet where not served by public sewer)
- Minimum lot width (65' where served by public sewer and 100' where not served by public sewer)
- Building setback (75' from the ordinary high water mark unless an existing development pattern exists and except for piers, boat hoists and boat houses. Recent legislation also permits certain, open accessory structures such as gazebos, within 35' of the ordinary high water mark)
- Vegetation buffers (in the landward strip of 35' from the ordinary high water mark, no more than 30' in any 100' may be clear-cut. The exceptions are for the removal of dead, diseased or dying trees)
- Earth disturbances (a permit is required to fill, grade, dredge, ditch and excavate or make lagoons and must be performed to minimize erosion, sedimentation and impairment of fish and wildlife habitat).

The state reviews county ordinances and where the county fails to adopt an ordinance or does not adopt an approved model ordinance; the state will adopt one. All Great Lakes shoreline counties have adopted ordinances. The state role also includes providing technical assistance and monitoring of local administration and enforcement of shoreline zoning and subdivision regulations.

Floodplain Management Program: Chapter NR 116, Administrative Rules, Department of Natural Resources

Municipalities are required by Section 87.30 (1) to adopt reasonable and effective floodplain zoning ordinances. The statute also spells out methods for determining flood hazard areas, requires adoption and enforcement of floodplain ordinances where serious flood damage may occur, and sets standards for development in floodway areas. The development standards include prohibitions in floodways of:

- Structures designed for human habitation
- Storage of hazardous materials
- Sewage systems
- Wells and other structures or facilities that would pose a risk.

NR 116 also contains standards for flood fringe and other floodplain areas, floodproofing, levees, channel improvements and procedures for changing the configuration of floodplains, floodways and flood storage areas.

Indiana

Indiana Code 14-11, Article 11. Powers and duties of the Indiana Department of Natural Resources

Sec. 1. The Indiana DNR may do the following:

- Investigate, compile, and disseminate information and make recommendations concerning the natural resources of Indiana and their conservation, including the following:
 - The drainage and reclamation of land.
 - Flood prevention.
 - Development of water power.
 - Culture and preservation of forests, fish, and game.
 - The preservation of soils.
 - The prevention of the waste of mineral resources.
- Cooperate with the appropriate departments of the federal government in conducting topographical and other surveys, experiments, or work of joint interest to the state and the federal government. As added by P.L.1-1995, SEC.4.

Administrative rules for most issues dealt with by the Indiana DNR have been recently repealed. New rules have not yet been promulgated.

The Indiana Code is fairly explicit in setting standards for flood areas. Primarily these are related to the Ohio and other rivers, but can also apply along the Lake Michigan shore and small rivers entering Lake Michigan. There are no shoreline erosion regulations.

Indiana Code 14-28, Natural Resources Commission and Flood Control

Sec. 12. The Natural Resources Commission has jurisdiction over the public and private waters in Indiana and the adjacent land necessary for flood control purposes or for the prevention of flood damage. The Commission is responsible to do the following:

- Make a comprehensive study and investigation of all pertinent conditions of the areas in Indiana affected by floods.
- Determine the best method and manner of establishing flood control, giving consideration to the following:
 - The reservoir method.
 - The channel improvement method.
 - The levee method.
 - The flood plain regulation method.
 - Any other practical method.
- Adopt and establish a comprehensive plan or master plan for flood control for all areas of Indiana subject to floods.
- Determine the best and most practical method and manner of establishing and constructing the necessary flood control works.
- Adopt appropriate measures for the prevention of flood damage.

A person may not do any of the following:

- Erect in or on any floodway a permanent structure for use as an abode or a place of residence, except as authorized.
- Except as authorized, erect, make, use, or maintain in or on any floodway, or suffer or permit the erection, making, use, or maintenance in or on any floodway, a structure, an obstruction, a deposit, or an excavation that will do any of the following:
 - Adversely affect the efficiency of or unduly restrict the capacity of the floodway.
 - By virtue of the nature, design, method of construction, state of maintenance, or physical condition do any of the following:
 - Constitute an unreasonable hazard to the safety of life or property.
 - Result in unreasonably detrimental effects upon the fish, wildlife, or botanical resources.

A structure, an obstruction, a deposit, or an excavation is a public nuisance. The Commission and all counties and municipalities shall consider the production of crops, pasture, forests, and park and recreational uses to be conforming uses.

Under Sec. 11. (a) The Natural Resources Commission may exercise the power of eminent domain. If the Commission is unable to agree with the owner for the purchase of: (1) land; (2) an easement; (3) a flood easement; (4) other interest in land; or (5) other property or right that in the commission's opinion is necessary for the Commission's purposes; the Commission may acquire the property or right by condemnation under IC 32-11.

All works of any nature for flood control in Indiana that are established and constructed shall be coordinated in design, construction, and operation according to sound and accepted engineering practice so as to effect the best flood control obtainable throughout Indiana. Plans and specifications must be approved by the Commission.

All counties and municipalities are encouraged and authorized to delineate and regulate all flood hazard areas within their respective jurisdictions by adopting and implementing all necessary ordinances, rules, and regulations under procedures established by law.

A county or municipality may not issue a permit for a structure, an obstruction, a deposit, or an excavation within a flood hazard area or part of a flood hazard area that lies within a floodway without the prior written approval of the Commission as provided in IC 14-28-1.

A county or municipality may establish a flood plain commission by ordinance of the unit's legislative body. The commission may regulate land uses within identified flood hazard areas under this chapter.

A local flood plain commission may make recommendations to the legislative body on the adoption of the initial flood plain zoning ordinance and amendments and any other matter within the commission's jurisdiction under this chapter.

A flood plain zoning ordinance may require that:

- A structure may not be located;
- A use may not be changed; and
- An improvement location permit may not be issued for a structure or change of use; on land either platted or unplatted within the jurisdiction of the commission unless the structure or use and location conform to the requirements of the flood plain zoning ordinance.

A flood control revolving fund exists. Loans may be made from the fund to local units to further flood control programs.

A flood control program includes the following:

- The removal of obstructions and accumulated debris from channels of streams.
- The clearing and straightening of channels of streams.
- The creating of new and enlarged channels of streams, wherever required.
- The building or repairing of dikes, levees, or other flood protective works.
- The construction of bank protection works for streams.
- The establishment of floodways.

Illinois

Illinois Compiled Statutes, Waterways, Rivers, Lakes, and Streams Act, 615 ILCS 5/

The Illinois Department of Natural Resources (DNR), on behalf of the State of Illinois, has jurisdiction and supervision over all of the rivers and lakes of the State of Illinois.

The DNR is responsible for obtaining data with reference to all of the waters of the State of Illinois, including original surveys, meander notes, maps, plats, river gauges, high and low water marks, and other sources of information which disclose or establish the rights of the citizens of the State of Illinois with reference to each body of water in the State.

Under this legislation, the Pollution Control Board, the Environmental Protection Agency, and the DNR and every resource of State government is to be applied to the proper preservation and utilization of the waters of Lake Michigan.

The Environmental Protection Agency is responsible for working in close cooperation with the City of Chicago and other affected units of government to:

- Terminate discharge of waste materials to Lake Michigan from vessels in both intra-state and inter-state navigation, and
- Abate domestic, industrial, and other pollution to assure that Lake Michigan beaches in Illinois are suitable for full body contact sports. The Environmental Protection Agency must regularly conduct water quality and lake bed surveys to evaluate the ecology and the quality of water in Lake Michigan.

The Illinois DNR is responsible for planning for the preservation and beautifying of the public bodies of water of the State, and for increasing public access.

A permit from the DNR is required to fill or deposit rock, earth, sand, or other material, or any refuse or build any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, causeway, harbor, or mooring facilities for watercraft, or build any other structure, or do any work of any kind in any of the public bodies of water within the State of Illinois. However, this requirement does not apply to duck blinds that comply with regulations of the DNR.

The building of any causeway, harbor, or mooring facilities for watercraft in Lake Michigan is confined to those areas recommended by the DNR and authorized by the General Assembly and approved by the Governor and must be in aid of and not an interference with the public interest or navigation.

It is permitted under statutory authority or under supervision of any park district or municipality to deposit dredged materials to any reclamation or fill-in of Lake Michigan where such materials are placed inside a bulkhead, wall or breakwater constructed to prevent the escape of such materials into Lake Michigan.

The DNR powers to promulgate rules or regulations, or to issue or deny permits, do not extend to barge mooring facilities in rivers located wholly or partly within the State.

The DNR may permit a person, firm or corporation, to take coal, gas, oil or other mineral or substance from or below the bed of any public waters within the State.

A permit is required from the DNR, to build or place in, upon or below the bed of particular portions of Chicago Harbor in Lake Michigan.

Floodplains

The DNR must define flood plains within the State of Illinois on a township by township basis and may issue permits for any construction within such flood plains on or after the effective date of the amendatory Act of 1971. In defining applicable flood plains, the DNR must cooperate with, and shall consider planning and zoning requirements of, regional planning agencies created by statute, counties, municipalities and other units of government.

The DNR must define the 100-year floodway within metropolitan counties located in the area served by the Northeastern Illinois Planning Commission, except for the part of that area which is within any city with a population exceeding 1,500,000.

The DNR may issue permits for construction that is "an appropriate use" of the designated 100-year floodway in metropolitan counties. If a unit of local government has adopted an ordinance that establishes minimum standards for appropriate use of the floodway that are at least as restrictive as those established by the DNR, and the unit of local government has adequate staff to enforce the ordinance, the DNR may delegate to such unit of local government the authority to issue permits for construction that is an appropriate use of the floodway within its jurisdiction.

No person may engage in any new construction within the 100-year floodway as designated by the DNR in such metropolitan counties, unless such construction relates to an appropriate use of the floodway. No unit of local government, including home rule units, in such metropolitan counties may issue any building permit or other apparent authorization for any prohibited new construction within the 100-year floodway.

"Appropriate use of the floodway" means use for:

- Flood control structures, dikes, dams and other public works or private improvements relating to the control of drainage, flooding or erosion
- Structures or facilities relating to the use of, or requiring access to, the water or shoreline, including pumping and treatment facilities, and facilities and improvements related to recreational boats, commercial shipping and other functionally dependent uses
- Any other purposes which the DNR determines, by rule, to be appropriate.

Appropriate use of the floodway does not include construction of a new building unless such building is a garage, storage shed or other structure accessory to an existing building and such building does not increase flood stages.

It is the duty of the DNR to prepare plans for the reservation or acquisition by the State of desirable tracts of land in connection with the public waters of the State of Illinois. This is for the purpose of public reservations or preserves for the use of all of the people of the State of Illinois, for pleasure, recreation and sport.

It is the duty of the DNR to maintain stream gauge stations, and to make careful investigations of the streams of the State with reference to the carrying capacity of all such streams in times of flood and under normal conditions; to prevent the carrying capacity of streams to be limited and impaired by fills, deposits, obstructions, encroachments therein, deposit of debris or material of any kind.

The DNR is authorized to carry out inspections of any dam within the State, and to establish standards and issue permits for the safe construction of new dams and the reconstruction, repair, operation and maintenance of all existing dams. The DNR is authorized, in case of existing dams, to require that the dams be maintained in a proper state of repair, and at a height for proper control of water levels in the disposal of flood waters and at normal stages, and for such purposes to require changes and modifications, and to compel the installation of fishways in dams wherever deemed necessary.

Title to the bed of Lake Michigan and all other meandered lakes in Illinois, set forth in the 1962 Report of the Department of Public Works and Buildings, Division of Waterways, entitled "Meandered Lakes in Illinois", with Map Appendix, regardless of the location, size or shape is held in trust for the benefit of the People of the State of Illinois and the DNR is the agency designated as the trustee authorized to exercise administrative jurisdiction and control.

The DNR, for the purpose of preventing fills, deposits of any character, or encroachments or other unauthorized uses in or upon any of the lakes or rivers of this State, and for the protection of navigation upon any of the navigable rivers and lakes of the State, or such rivers and lakes as are capable of being made navigable by improvement, is authorized and empowered to lay out and fix shore or harbor lines through any city or municipality, or at any other locality where public interests may require, and to authorize the construction of retaining walls under proper restrictions and conditions. Any person or persons, city or municipality, or other agency, desiring to erect such wall, must first secure a permit from the DNR.

After July 1, 1985, no person, State agency, or unit of local government may undertake construction in a public body of water or in a stream without a permit from the DNR.

Maintenance and repair of improved channels, ditches or levees must follow accepted practices to reduce, as practical, scour, erosion, sedimentation, escape of loose material and debris, disturbance of adjacent trees and vegetation, and obstruction of flood flows.

9.3 Evaluation of Program Effectiveness

RAMS Data Evaluation

The RAMS data base record compiled from the State of Michigan Department of Environmental Quality, the Wisconsin Department of Natural Resources and the US Army Corps of Engineers shoreline permit applications was examined for patterns of permit granting policy and location of different shoreline structural protection types. There were nearly 1,200 records listed for Ottawa and Allegan Counties and 136 for Manitowoc, Ozaukee and Sheboygan Counties in Wisconsin. Due to the vagaries in the data, no real conclusion is possible, except

that the records of permit activity are very incomplete and inaccurate. The records do not consistently list the nature of the permitted activity and often have an illogical location identified, such as the middle of the lake or somewhere in Leelanau County.

While the flooding regulations have the most similarity between the four states (probably because of the NFIP), there are substantial differences in the extent and approach to shoreline regulations. (See also comments in Section 4.0.)

The state programs appear to be partially effective in limiting damages along the shoreline hazard zones. Where there are state programs, they are implemented in a combination of state and local administration. There is no common set of regulatory standards, nor any consistent level of implementation of adopted regulations along the entire Lake Michigan shoreline. Nor is there any assurance that over time, a common set of hazard mitigation goals will be formulated or accomplished. It would seem that the biggest gains in program effectiveness could come from a common state and local approach to shoreline management. If state and local laws and roles were made common, and if interstate standards and comprehensiveness of regulatory programs were more common, then the predictability and consistency of state and local shoreline programs would be better and potential damages would be less. In the absence of common state laws and local regulations, if there were common agreement on existing threats, potential damages, structural shoreline protection options and effects, model local and state regulatory and non-regulatory approaches and on a set of technical assistance materials to consistently deliver these messages to a range of targeted audiences (in the most effective way), this would seem to be a major goal worth achieving.

10.0 HABITAT REGULATIONS

10.1 Overview

Federal and state legislation has been enacted to protect coastal resources and habitat along the Great Lakes shoreline. Habitat regulations are intended to ensure the protection of areas providing specialized habitat requirements to aquatic or terrestrial life.

Habitat regulations help limit potential damages when they serve to prohibit development of habitat areas that are also hazard areas. This is often the case with wetlands and sensitive dune areas.

Federal legislation that applies to Lake Michigan includes Sections 9 and 10 of the Rivers and Harbors Act and Section 404 of the Federal Water Pollution Control Act, now known as the Clean Water Act. With these pieces of legislation, the US Army Corps of Engineers has permit authority over dredging, fill and construction in wetlands connected to the Great Lakes. In certain unconnected wetlands, the State of Michigan has wetland permitting authority through Part 303 of the Natural Resources and Environmental Protection Act, PA 451 of 1994 as amended.

11.0 DEVELOPMENT CONTROLS FOR PUBLIC INFRASTRUCTURE

11.1 Overview

As indicated in the 1993 IJC Report, the placement of public infrastructure (roads, bridges, sewer, water and government facilities) has the potential to influence shoreline development, with major, long-term implications. Public infrastructure investment can both:

- Encourage and facilitate private development in hazard zones, and
- Become a casualty to erosion and flooding.

The concept of "development controls for public infrastructure," (defined in the 1993 IJC Report as designing and locating public infrastructure outside of recognized hazard areas to reduce the potential for future losses) is probably not provided the best label. It may be more helpful to discuss public infrastructure in the context of public policy, capital improvements programming and growth management or smart growth. Policy development and financial planning for infrastructure investment occurs at the local, county, regional, state and federal level. The goals, policies and expenditures of these different levels of government are rarely well coordinated and can often be at odds. For example, a local community may seek the tax revenue of new shoreline development while the county in which the community is located may see improving roads (to the potential development area) that are at risk of flooding or wash-out as an unacceptable risk.

11.2 State Infrastructure Investment

11.2.1 Parks

Michigan

Both high and low Lake Michigan levels have been a problem for Michigan State Parks. Bluff erosion has periodically been very significant at many Lake Michigan parks, especially Orchard Beach in Manistee County.

Low lake levels were the cause of many boat access problems along the Lake Michigan shoreline in 1999. While dredging could solve most of the problems, there is no funding available to correct all problem sites. As of early 2000, the DNR was trying to determine how to prioritize sites for dredging.

According to the Parks and Recreation Division of the DNR, there are no current plans for acquiring additional Lake Michigan shoreline property so debate about how to accommodate a wide range of lake levels in park facility design revolves around existing park facilities.

Wisconsin

Wisconsin State recreation department staff report that some facilities, such as docks, need to be redesigned due to low lake levels. However, fluctuating lake levels are not considered in acquiring or developing lakeshore parks. Whitefish Dunes and Door Peninsula parks have been affected by considerable shoreline erosion. At the present time, State officials are only planning for a new park in downtown Milwaukee. It will include 4 acres of shoreline.

Indiana

State parks staff report that no state facilities need to be redesigned due to low lake levels. In fact, Lake Michigan levels are not considered in acquiring or developing lakeshore parks. However, bluff recession has affected recreation properties. Indiana has no policy to stop erosion on state or public land. For example, Mt. Baldie is eroding at 10-12 ft per year, while the normal rate is 3-4 ft. They have performed beach nourishment on this area, by trucking sand to the area eroded. Along the Indiana shore, private property owners often put up seawalls or sand traps to stop from losing their sand.

Illinois

There has been some response to low lake levels in State park facilities in Illinois. The North Marina was designed to accommodate fluctuating lake levels. Fluctuating levels are considered in acquiring or developing lakeshore parks. Fluctuations are a problem for Illinois parks. Shoreline erosion is causing sand migration with the result of low sand levels on the northern beaches. Beach nourishment is performed every year.

11.2.2 Highways

Michigan

MDOT identified coastal emergency projects primarily within the Coastal Zone Boundary. Ms. Jeri Ayers in MDOT's Environmental Division suggested that during the 1980's there were several projects that were in response to high lake levels. Projects included M-116 near Ludington, M-22 near Alberta, M-2 in Mackinac County, M-37 on the Old Mission Peninsula near Mission Point, and US-31 in Traverse City on Grand Traverse Bay.

Wisconsin

WDOT reported that they have not had significant problems since the 1986 high water levels. They documented three roads that had to be moved in places where flooding and erosion were major concerns:

- Manitowoc County: Highway 42,
- Sheboygan County: Highway S,
- Racine County Road.

Low lake levels do not seem to be a threat to coastal Wisconsin roads.

Indiana

No problems were reported from the La Porte Regional Indiana Department of Transportation office.

Illinois

Mr. Steve Nadalis of Illinois Department of Transportation spoke of several recent revetment projects on the Lake Michigan shoreline that were within the Chicago Metropolitan Area. He noted that these projects were likely needed because of erosion and years of flooding.

11.3 Local Infrastructure Investment

11.3.1 Water Treatment Plants

Most of the major cities along Lake Michigan take water from the Lake for drinking. It is a practical matter that these be placed in relatively close proximity to the Lake, but it is not necessary to place them right on the shoreline.

Water treatment plants placed on the shoreline and in the floodplain, face flooding and erosion damage. If flooded, the entire service area of the treatment plant may become contaminated, with the potential for tens of thousands of people becoming sick. While erosion could conceivably cause damage to the facility, it is most likely that the community will use shore structures to protect the facility, at whatever cost. To date, at least one water treatment plant near the Lake Michigan shoreline, in Milwaukee, has been flooded by high waters. This facility was flooded by high river waters, not by a high Lake Michigan. However, a backflow effect from a high lake level could contribute to higher river elevations during flood conditions.

11.3.2 Sewage Treatment Plants

Sewage treatment plants are usually located near a water body to permit dilution of the effluent. Even though the sewage is treated, it still contains a concentration of nutrients that requires mixing with uncontaminated water. If a sewage treatment plant is flooded, flood waters can become highly contaminated and pose a serious health hazard. While there are no reports of this happening along the Lake Michigan shoreline or its estuaries, there could be problems associated with high rainfalls during periods of extremely high Lake Michigan levels. Based on informal discussion with local officials, it appears that sewage treatment plants are built with consideration for 100 year flood elevations. The US Army Corps of Engineers projects possible Lake Michigan levels higher than the 100 year flood level if there are extended periods of wet weather.

11.4 Quasi Public and Nonprofit Investment

Quasi-public and nonprofit investments include power plants, colleges, conservancies and church camps. Power generation plants, especially nuclear power plants represent a huge investment.

Table 6 shows some companies with power generating plants on Lake Michigan. Plant managers were asked about concerns with both high and low water. They were also asked about plans for future facilities. Would extreme lake levels become a factor?

Table 6
LAKE MICHIGAN SHORELINE POWER GENERATING PLANTS

Company	Power Plants on Lake MI	Is low lake level a concern?	Are new facilities planned with more extreme levels a factor?	Was extreme high lake level (beyond a 100-year flood) considered in siting and designing the facility?
Wisconsin Elec. Power Co.	Ozaukee Manitowoc	No	No, air quality a bigger concern	Facilities too old, before floodplain studies
NIPSCO, IN	Michigan City Gary Bailey (water intake problems due to sand erosion)	No	No new facilities	All built in the 1960's and 1970's. Was not aware of elevations of current facilities.
Consumers Power, MI	Palisades Nuclear Plant in South Haven Muskegon Lake J.H Campbell (between Holland and Grand Haven) Ludington (hydro)	No	No new facilities	Muskegon plant may be in floodplain, but none of the plants were damaged in mid-80's, so they don't anticipate problems.
Traverse City Light & Power	Traverse City (will be decommissioned in 2009)	No	No	No, built in 1940's
Commonwealth Edison, IL	Waukegan Zion Nuclear (closed one year ago)	No	No new facilities (sold one recently)	100 year flood plain

At the focus groups in 1999, one representative of an electric power company expressed the view that at least one of their sites would be damaged by potential, extremely high Lake Michigan levels more recently projected by the Corps of Engineers. There may not be an awareness or belief among facility

managers that Lake Michigan could reach high levels above those experienced in the past 30 years.

Conservancies

While the states and federal government continue to purchase land either to limit development damage in hazard areas or to provide recreational opportunity, the rate at which these purchases are made is inconsistent and is highly dependent on funding. Shoreline land is usually expensive, so coastal sites must be high priority or unique sites to be purchased by either conservancies, states or the federal government. For example, Michigan has no current plans to purchase additional shoreline property (Anthes, 2000). Because the states do not acquire land for recreational purposes through condemnation, acquisition is also dependent on the availability of large or contiguous parcels. Much of the shoreline has already been divided into relatively small parcels. Also, portions may require extensive environmental clean-up before being used by the public. Indiana has purchased shoreline property fairly aggressively in the past, but is wary now because of potential contamination mitigation costs (Lucas, 2000).

Conservancies both purchase or receive donations of land. Again, due to its high cost, Great Lakes shorelines are not purchased as often as parcels farther inland. Also, conservancies generally obtain land for habitat protection and not for general recreation purposes.

It was not possible to determine the extent of conservancy-owned land along the Lake Michigan shoreline. There are some conservancy properties and the coastal and estuarine ownership continues to grow. None of the state coastal DNR programs or nature preserves had any list of all properties. Conservancies keep track of only those they own. For Indiana there is a list that is being put together by the Office of the Great Lakes but not yet completed.

There are 45 miles of Illinois shoreline on Lake Michigan, of which about 30 miles are publicly owned. Chicago owns about 28 miles of the shoreline and the state DNR owns about 2 miles.

In Michigan, there is also no complete list. The Nature Conservancy owns Point Betsie in Northwest Michigan. The Macatawa Area Land Conservancy has recently acquired two parcels of wetlands along the shore of Lake Macatawa.

In Wisconsin there is no documentation of private or nonprofit protected lands, only those owned by the state. There are 44 land trusts in the state, as of late 1999. State land along the Wisconsin Lake Michigan shoreline includes: Harrington Beach (1 mile), Point Beach (7), Kohler-Adarae (2) and Newport (11).

The information on land acquisition under FEMA sponsored programs in the 1993 IJC Report remains fairly accurate. However, there has been little land acquisition activity along the Lake Michigan shoreline.

11.5 Extent of Application

All shoreline communities and multiple levels of government invest in infrastructure construction and improvements to some extent. There is no data base to identify how much is invested in the coastal zone. It is probably accurate to say that the investment is increasing.

11.6 Effectiveness

The application of infrastructure investment policy can be a highly effective tool in managing land use in shoreline hazard areas. By deciding to limit investment there, communities can limit the risk to publicly owned facilities and slow the private investment served by public infrastructure.

It is uncertain if a moratorium on public road, sewer and water investment would permanently slow or halt private development. The attraction to the coastal zone is so great that private investment in roads, sewer and water systems may fill the void if the public did not build the infrastructure.

11.7 Compatibility/Indirect Effects

A widely adopted policy to limit public infrastructure in or serving shoreline hazard areas could serve to limit economic damages, reduce potential pollution from impervious surfaces and accidental discharges from sewage treatment and distribution systems, retain natural floodway hydrology and enhance natural scenic quality.

11.8 Implementability

The 1993 IJC Report cites legislation in other coastal states and the US Government (Coastal Barrier Resources Act, 1982) that prohibits subsidies for the construction of access (causeways, bridges, etc.) to barrier islands that are hazard areas.

It is possible to extend this type of policy to other hazard areas. It may be some time before there is political will and awareness of potential damages to extend such policy to Lake Michigan shoreline hazard areas.

12.0 LOANS

12.1 Overview

In response to natural hazards associated with flooding and erosion, shoreline property owner assistance programs can be established through which loans are provided to facilitate program implementation.

The use of loans to manage shoreline land use appears to be a tool not presently used along the Lake Michigan shoreline.

13.0 GRANTS

13.1 Overview

Grants could be used to encourage wise use of the coastal area through:

- Policy that eliminates all grant programs that provide incentives for any type of capital intensive development in floodplains or erosion hazard areas.
- Providing grants as incentives to implement non-structural shoreline protection measures or removing existing structures that have been damaged or destroyed or are contributing to a potential loss.
- Providing financial support for educational efforts to help local officials and citizens better understand Lake Michigan hazard areas.
- Providing financial support for local units of government to prepare plans and zoning ordinances that deal with development in natural hazard areas.

There does not appear to be coordinated policy at the state or federal level to use grants to minimize shoreline development along the Lake Michigan shoreline so that structural damage is minimized.

The Emergency Home Relocation Program conducted by the Michigan Department of Natural Resources was an example of such a program, but it ceased in 1988. (See Section 4.2.1.)

The Wisconsin Lakes Partnership, Lake Planning Grants program is available to provide funding for local governments and lake management organizations for the collection and analysis of information needed to manage lakes. Eligible activities include data gathering and analysis of water quality and land use information, evaluating ordinances pertaining to zoning and other issues, and developing alternative courses of action. This program provides a 75% state cost-share.

14.0 INSURANCE PROGRAMS

14.1 Overview

This measure would use insurance as an implementation tool to encourage municipalities to adopt floodplain management programs. See the discussion on mitigation in Section 4.0, beginning on page 39. The concept is to require compliance with certain mitigation measures that would reduce potential damages in order to be provided with insurance. Broadly applied, the concept could apply to a variety of hazards, not only flooding.

The National Flood Insurance Program (NFIP) is the source of flood insurance for properties in coastal or floodplain hazard areas. The Program provides coverage to replace contents and to repair or replace structures damaged by flood or coastal erosion. To qualify, the properties must be in communities that participate in NFIP. To participate, the communities must map the hazard areas and develop education and mitigation programs. Nearly 20,000 communities, nation-wide participate. Still, only about 20% of at-risk properties are enrolled.

When communities implement mitigating measures, it may reduce insurance premiums, depending on the resultant rating of the community.

Under the National Flood Insurance Program Reform Act, if a building is located within a federally identified special flood hazard area (100 year floodplain), and is securing a loan from a federally regulated, supervised or insured lender, flood insurance must be required as a condition of the loan. If the lender fails to require flood insurance on a structure in the special flood hazard area, the lender may be fined. Currently, a structure could be built within a floodplain that is not a federally identified floodplain without flood insurance.

As discussed in Section 4.0 Flood Proofing and Hazard Mitigation, it is important to ensure that properties damaged by floods perform some mitigating activity to limit future damage. Otherwise, the insurance actuarial tables would drive the costs of the insurance above an affordable level. It makes sense then, for those who pay flood insurance premiums to demand that owners of those properties where repeated damage is nearly certain, elevate above, or remove their structures from the hazard. Recent legislation, H.R. 2728, to amend the National Flood Insurance Act of 1978, would eliminate properties from the program where repetitive insurance claims were made. The bill, "Two Floods and You are Out of the Taxpayers Pocket Act of 1999," remains in the House Committee on Banking and Financial Services.

FEMA has been evaluating the impacts of erosion and erosion mapping on the economic viability of the NFIP. While the evaluative study, conducted by the Heinz Center, has not yet been released, early reports suggest that there is some risk of the NFIP losing money in the erosion zone in the future. Since 1981,

NFIP has been making money in the erosion zone. This is due, in large part, to improved building standards in flood insurance risk map (FIRM) hazard areas.

14.2 Extent of Application

The NFIP is little used along the Lake Michigan shoreline. State officials estimate that as few as 15% of all flood prone properties in Michigan are covered by flood insurance.

Bluff erosion is only covered under NFIP when water levels exceed anticipated cyclical levels. For Lake Michigan, this is the 1973 level. Properties where bluff erosion may be a problem can obtain flood insurance but would not be required to do so unless close to a river prone to flooding.

NFIP hazard mapping identifies areas within the 100-year floodplain but there have been damages to properties in the US within the 500-year floodplain. There is some mapping of the 500-year floodplain but Congress has not considered changing the NFIP to consider that level as a standard. Flood insurance policies are written for properties within the 500-year floodplain, and the NFIP is losing money on those policies.

14.3 Effectiveness

On the surface, it appears that insurance programs offer a tremendous opportunity to foster sensible development patterns and building standards. To date, the opportunity has been largely ignored by property owners.

A program did exist in the late 1980s and early 1990s to foster mitigation related to potential structural losses due to erosion. This was the Upton Jones Amendment to the National Flood Insurance Act. It provided assistance for the relocation (40% share) of structures from high risk to low risk locations and demolition of structures (110% cost share) that were in imminent danger of collapse. Upton Jones was renewed several times but dropped in 1995. It was planned as a mitigation tool to promote relocation of structures. It was used primarily for demolition. While this served to remove buildings that were potential public safety problems, it also served as a public handout for property owners to get rid of old buildings at risk of collapse. The Upton Jones program lost money.

In the most serious flood prone areas more direct action (like public acquisition of the property) may be the better alternative. A minimum shoreline setback from the waters edge and from the top of the bluff, plus a greater setback in documented high risk erosion areas, along with deeper lots and better movable structure requirements (as an alternative to some deep setbacks), are likely to be more effective solutions than broadened insurance programs, given the low participation rates.

15.0 DEED RESTRICTIONS/DISCLOSURES

15.1 Overview

Deed restrictions and disclosures are approaches to damage reduction that require sellers to list flood and erosion hazards on real estate disclosure forms and/or deeds and depend on the potential buyer of property to make a wise purchasing decision based on information about the hazards faced by a property under consideration. The potential buyer would either:

- Avoid buying the property based on the information
- Limit investment in the property once it is purchased due to the likelihood of future damages.
- Negotiate a price reduction or mitigating measures with the seller.

Deed Restrictions

As explained in the 1993 IJC Report, deed restrictions are notices placed on property deeds so the future buyers of shoreline property are aware of the potential hazard of flood or shoreline erosion. If a restriction beyond a notice were placed on the deed, it could limit the extent and location of future development on the property or even prohibit substantial development entirely. A buyer who violated such a restriction on the deed could potentially lose the property.

According to discussions with state officials in all four Lake Michigan states, deed restrictions are not required for properties with shoreline hazards. The 1993 IJC Report indicates that the Great Lake state of New York recommends that property in coastal hazard areas should have that designation recorded on maps and official records.

Real Estate Disclosure Requirements

A practical approach to informing prospective buyers about potential hazards is the real estate disclosure form. According to the 1993 IJC Report, this is a mandatory warning, placed on the deed or a form provided to potential buyers when the property is for sale. It informs prospective buyers of any potential hazards and discloses any past damage or repair costs associated with flooding or erosion.

In Ohio, disclosure requirements are implemented through the Erosion Hazard Setback Permit Process. As erosion hazard areas are mapped, the state must notify property owners who must, in turn, notify any potential buyers. Michigan does notify all owners of property within designated high risk erosion areas of the status of regulations that apply to their property. This notice does not run with the deed nor are prospective purchasers notified.

Michigan's real estate disclosure law does not require disclosure of property location within a floodplain, but does require sellers to list if there has been *"settling, flooding, drainage, structural or grading problems,"* and if there has been *"major damage to the property from fire, wind, floods, or landslides."* These are all after the fact disclosures.

Wisconsin requires real estate forms to indicate if any of the property is located in a floodplain or if the owner has had any notice that the property has any shoreland or special land use regulations affecting the property.

Neither Indiana or Illinois has a real estate disclosure requirement that considers shoreline hazards.

Three other coastal states require real estate disclosure of shoreline hazards. These are Massachusetts, South Carolina and Texas. Most states rely on a *caveat emptor* ("buyer beware") philosophy and place the responsibility for property inspections on buyers. (Godschalk et al, 1998).

The idea of real estate disclosure was raised at the 1999 focus groups. However, Godschalk et al, found that real estate agents are not considered reliable sources of information on properties, suggesting that some independent form of disclosure was needed. Perhaps home inspectors could be trained to offer this service.

Clearly however, this is an area where minor modifications to existing laws to require notice to property owners that are located in floodplains, wetlands, high risk erosion areas and designated sand dune areas of the hazards associated with such property would be a useful education tool. Also requiring disclosure of such information on seller disclosure forms would extend the information benefit further. It also presents numerous opportunities to include real estate and financial institutions in the real estate education process and possibly also to extend certain opportunities and obligations to them associated with notice of coastal hazards to prospective purchasers.

16.0 TAX INCENTIVES

16.1 Overview

Incentives and disincentives are designed to affect floodplain development indirectly by influencing individuals and firms to calculate the advantages and disadvantages of building on a particular site. Incentives and disincentives can also be tax related consisting of a variety of steps to provide property tax relief, tax abatements, tax penalties or tax collection for a specified purpose.

According to the 1993 IJC Report, there are tax incentive programs in the United States that provide tax relief to property owners who maintain their property as a flood storage or wetland area. In Michigan, there are tax incentives to maintain land in farming instead of developing it, but no explicit state program pertaining specifically to flood or erosion hazard areas. However, the open space provisions of the Farmland and Open Space Protection Act, now part 361 of PA 451 of 1994, do permit local governments to reduce taxes on property to be classified as open space for a designated period. While very few such designations have been made (because of the direct loss of property tax revenue), there is no reason the statute could not be used in some floodplain and high risk erosion situations.

It is difficult to adopt tax incentives for measures that enhance sustainability in communities. Property taxes are determined by the local millage rate and the assessed value. Within limits (such as that imposed by the Headlee Amendment in Michigan) communities have some flexibility in taxation of properties. There is often little official support to lower taxes. Land is often assessed at its "highest and best use," which is usually interpreted to mean a developed use. Where there might be an appropriate place to provide a tax assessment, such as to not develop a flood or erosion hazard site, local communities may resist, seeking the maximum tax return from the property. As long as local communities with marginally developable land, undevelopable land or unique and sensitive resources have to provide the funds for most of their services from local property taxes, there will be little motivation to provide tax incentives for not developing property or for developing it less intensively than would otherwise occur.

17.0 CONCLUSIONS AND RECOMMENDATIONS

17.1 Overview

This section responds to the findings of this 1999 update of the 1993 IJC Report, offers conclusions and recommendations and provides a summary evaluation table of each of the shoreland management tools. Each tool is evaluated against objectives. These include the two developed for the 1993 IJC Report and three presented in Section 2.3.1 as part of the 1999 report.

17.2 Conclusions

Shoreline land use management tools exist to foster sustainable development. These tools include:

- Land use and resource inventories
- Master Plans
- Zoning Ordinances
- Setbacks
- Public infrastructure investment policy
- Flood and erosion hazard mitigation planning
- Land acquisition policy
- Shoreland regulations
- Habitat regulations
- Deed restrictions and real estate disclosures
- Loans
- Grants
- Insurance programs
- Tax incentives

Each of the above measures is evaluated against the following five objectives in Table 7.

Objective 1: Reduce damages to structures and property from erosion, flooding and extreme high and low water impacts. (1993 IJC Study)

Objective 2: Reduce loss of shoreline property and structure use from erosion, flooding and extreme high and low water impacts. (1993 IJC Study)

Objective 3: Investigate or conjecture whether some shoreline management approaches can be effectively, efficiently and fairly established and implemented by local units of government while others can best be established and/or administered at the state level. (New objective)

Objective 4: Investigate whether education and technical assistance to existing and prospective property owners and to supporting real estate

and banking interests can greatly reduce unwise decisions on shoreline structure siting and shore protection investments. (New objective)

Objective 5: Speculate whether, over a period of time, the private sector could assume a principal responsibility and liability for ensuring the safe siting of structures in areas prone to flooding or erosion. (New objective)

For the most part, the observations on Table 7 in cells related to objectives 3 through 5 are speculative and require further research or pilot testing to prove their worth. However, given the wide variation in approaches in place in the various states, the general lack of support for more regulatory programs that require new tax dollars and the large number of properties affected, it appears worth investigating further the benefits of targeted education campaigns and private sector implementation of a few new consistent regulatory approaches.

Only a few of the wide variety of shoreland management tools available to limit damages in Lake Michigan shoreland hazard zones are widely applied. Most frequently or thoroughly applied are shoreland regulations, zoning ordinances and setbacks. Other tools, such as insurance programs, resource inventories, master plans, hazard mitigation planning and public infrastructure funding are available (and used in other states for reducing the likelihood of future damages in natural hazard zones) but are seldom or ineffectively used to protect against Lake Michigan potential hazards.

The most frequently used tools at the local level (zoning, setbacks and shoreland regulations) are among the least effective in reducing damages where they fail to site development outside of the hazard area. In many Michigan communities these tools serve to modify development in hazard areas or to regulate and monitor structures used to protect developed property, but often do not reduce the value of property in hazard areas. The Wisconsin DNR reports that counties that have adopted setback standards exceeding the minimum (Manitowoc, Sheboygan and Ozaukee Counties) have been very effective in siting development outside the hazard area. The regulations of the state of Michigan are also effective at preventing new structures in hazard areas. However, a comparable level of achievement has not been reached with flood hazard or high risk erosion area regulations in already developed areas. The least used tools (e.g. deed restrictions, loans, grants, etc.) either serve to educate property owners and decision-makers, limit shoreland development or limit public financial responsibility for losses.

The extent of potential economic damage from extreme Lake Michigan levels is due, in part, to past decisions to heavily invest in developing shoreland hazard areas. (An estimate of the potential economic damage is being prepared as a separate task.) Potential damages includes both private residential, commercial and industrial development, the public infrastructure to support this development and public facilities, such as power plants and water and sewage treatment plants.

The large extent of potential damages is also due to the lack of knowledge of the extreme levels, both high and low, that Lake Michigan can reach. Developmental planning has occurred on the basis of a more moderate estimate of highs and lows (100-year rather than 500-year). The result is considerable property at risk for damage from bluff erosion and flooding.

There is a momentum to continue shoreland development for the following reasons:

- The shore is a powerful attracting force for residential development.
- The shore is convenient for certain public facilities, such as water treatment plants.
- There is an accepted belief among local governments that the tax revenues from shoreland properties is greater than the costs to service them or repair damaged infrastructure.

Although state-mandated setbacks exist in both Michigan and Wisconsin, these may not be sufficient to protect properties within the next fifty years on shore segments where past structure siting close to the bluff and limited parcel dimensions will limit future choices to respond to bluff retreat. In addition, there is no consensus on a common set of shoreline management goals or on a strategic management approach between Michigan and Wisconsin, let alone between all the other Great Lakes states and Ontario. Without a common set of shoreline management goals and a common strategy, every measure initiated at the state or local level is just another experiment that may or may not contribute to reducing damages in hazard areas.

A knowledge gap among property owners and local decision-makers is, in part, responsible for placing development at risk for potential damages. This knowledge gap consists of the following:

- A good understanding of the location of hazard areas. Local decision-making *could* limit the private and public investment and thus loss in hazard zones. Master plans could identify hazard areas based on resource inventories and set goals for limiting investment there. A few communities along the study area do so but most do not. Until local planning adequately recognizes Lake Michigan-related hazards, investment is likely to continue.
- Range of lake levels. Because planning has considered only the 100-year flood level and a moderate range of Lake Michigan levels, shoreland investment may continue to occur that is at risk from more extreme, but highly possible, 500-year flood levels and lake level extremes. The wider extremes of lake level and more accurate bluff recession rates that are emerging represents new knowledge for shoreland communities. Past planning, including the decision that planning to deal with Lake Michigan-related hazards is unnecessary, has not had the benefit of improved information.
- The potential public costs of damages. Local communities probably have little idea of the potential loss or replacement costs in public investment for

infrastructure or public facilities located in hazard areas. Individual shoreland property owners may hope for or expect the public investment or reinvestment will continue following damages or the knowledge of the potential extent of damages. Local officials and taxpayers may not fully understand the size of the public burden to support shoreland development or public facilities in the hazard areas and may not support a continued at-risk investment.

- Missed opportunities for use of other shoreland management tools. Local communities may not understand that there are other tools, such as insurance programs, hazard mitigation planning, land acquisition and other tools that can help reduce potential damages. However, local communities may be consciously making the choice not to apply these tools because they do not want to discourage shoreland development (because of the tax revenues) and are hoping that the risk will never materialize.
- Commitment at the state level to implement and support a wide variety of shoreland management tools. With a trend to minimize state and federal governmental roles in land use decision-making, it may be difficult to fully fund and staff programs to apply such tools. However, where the hazards still exist, some entity may be called upon to oversee a wide range of tools to manage shorelands to reduce potential damages.
- The private sector which provides real estate services is not an active participant in efforts to minimize hazards to shoreline development. Yet there is considerable opportunity to both reduce regulatory costs and increase effectiveness if they were actively involved.

17.3 Recommendations

The first recommendation is to develop consensus between Michigan and Wisconsin (at a minimum) and the other Great Lakes states and Ontario (preferred) on a common set of goals and a common management approach to minimize hazards from flooding and erosion in shoreline areas. As noted in Section 3.3, a combination of the current Wisconsin and Michigan shoreline regulatory approaches would be much more effective at reducing the number and value of new structures in areas at high risk of erosion. Preventing new structures in high risk flooding areas and aggressive use of land purchase and relocation of existing structures in high risk flooding areas, would also, over time, dramatically reduce potential damages in these areas. However, the first step has to be establishing these as objectives and agreeing to a common management approach.

The second recommendation is to recognize the unique role and benefits that the state and local governments can play in reducing damages in hazard areas. The Great Lakes states and Ontario need to define the overall management approach and then pass or modify existing laws to reflect the management strategy. This would include at a minimum:

- The elements and standards for flooding and erosion management programs.

- Enabling authority for local regulation and a requirement for state regulation where locals choose not too.
- Adequate staffing and training of state staff to carry out the state obligation in those shoreline areas where local governments choose not to regulate (generally the most rapidly eroding areas, and areas with a large number of properties at high flood risk).
- Provision of model ordinances and technical assistance to local governments, realtors, bankers and property owners.
- Adequate monitoring and enforcement staff in addition to staff to periodically update erosion and flooding studies.

In contrast, local governments have a distinct advantage in being able to educate, assist and guide property owners within their jurisdiction (compared to state agencies). For this to be effective, they must be aware of the broader goals and threats, be well informed about options and opportunities to deal with these threats and be provided with model ordinances and technical assistance as needed. A partnership between well-trained state agency staff and local officials is essential for this model to be most effective.

The first two recommendations are essentially an expanded version of the model Michigan is presently using. This model holds considerable promise and is consistent with the first two objectives of this study. It also reflects the new third objective. However, it may be more costly over-time than a public-private partnership model embodied by the last two (new) objectives. Objectives four and five reflect the principle that regulations and programmatic goals are easiest and least costly to administer when they are highly valued by all who are most affected by them. This includes shoreline local officials, property owners and all the support industry personnel (including realtors, bankers, etc.).

The third recommendation is related to the fourth objective and targets providing education and technical assistance to real estate and financial institutions on the hazards associated with shoreline development, as well as on the risks of such development to their respective occupations and businesses. It may take targeted statutory changes for this to be most effective. For example, changing the Michigan Seller Disclosure Act (Public Act 92 of 1993) may be needed to require sellers to disclose if their property is in a designated floodplain or high risk erosion area. This of course would also require official government notice to all property owners so situated and easy access to this information by property owners, realtors and financial institutions. Recording this information with the deed for each property would be another beneficial step. Each of these efforts would enhance the chance that potential new shoreline owners were well informed about shoreline hazards and potential damage risks before making unwise investments. However, these efforts will have marginal value without enforcement and penalties for those who fail to comply.

The fourth recommendation goes one step further and is consistent with the fifth objective. It seeks to determine if implementation of shoreline management strategies cannot be achieved in great measure by actions of real estate and financial institutions in their day-to-day dealings with clients. This may require shifting some liability to land surveyors, engineers, architects, landscape architects, realtors, banks and title companies for actions taken in violation of state shoreline management laws. By requiring these professionals to incorporate hazard information into their designs and decisions, it is expected that fewer new shoreline property owners would invest in shoreline property ignorant of relevant hazards and laws. Administration of regulatory provisions should also be easier because of broader and deeper understanding of requirements. At least one Michigan DEQ official has suggested dropping minimum required setbacks in return for a statutory standard that shore protection structures will not be permitted on Great Lakes bottomlands and there will be no government support when disaster strikes--no loans, subsidies or relocation support. This would represent a complete shift of responsibility to the private sector and recognize natural hydrologic processes.

Together these four recommendations have the potential to significantly reduce threats to health and damages to property in shoreline hazard areas. They are worthy of further study to flesh them out in greater detail and to determine their political and practical feasibility.

Table 7
EVALUATION OF SHORELAND MANAGEMENT MEASURES

Objectives	Land use and resource inventories	Master Plans	Zoning Ordinances	Setbacks	Public infrastructure investment policy	Flood and erosion hazard mitigation planning	Land acquisition policy
Objective 1: Reduce damages to structures and property from erosion, flooding and extreme high and low water impacts	Provides information needed for wise decision making.	Could promote low risk use of high hazard lands.	Can serve to configure development of properties to minimize risks and implement master plans.	Works best when strictly applied and few variances approved.	Can help direct investment away from hazard areas to reduce loss.	Can be effective if communities endorse.	Can be effective but expensive and communities often prefer high value development.
Objective 2: Reduce loss of shoreline property and structure use from erosion, flooding and extreme high and low water impacts.	Provides information needed for wise decision making.	Could promote low risk use of high hazard lands.	Can serve to configure development of properties to minimize risks and implement master plans.	Works best when strictly applied and few variances approved.	Can help direct investment away from hazard areas to reduce loss.	Land loss and inundation is likely but structural damage can be minimized.	Shifts losses to public owner or conservancy.
Objective 3: Investigate whether some shoreline management approaches can be effectively, efficiently and fairly established and implemented by local units of government while others can best be established and/or administered at the state level.	Inventories are usually made available by state agencies for use by local governments, who should use them to help guide decision making.	Most effective at the local level measured against regional or state standards.	Local units of government want state backing so they don't have to be "the bad guys."	Local units of government want state backing so they don't have to be "the bad guys."	Difficult because local communities want the tax revenues of shoreland development that infrastructure facilitates.	Local communities are an appropriate level for this but often encourage hazard area development for tax revenue.	Local communities often don't have the resources to acquire or manage large areas of hazard prone land.

Table 7 (Continued)

Objectives	Land use and resource inventories	Master Plans	Zoning Ordinances	Setbacks	Public infrastructure investment policy	Flood and erosion hazard mitigation planning	Land acquisition policy
Objective 4: Investigate whether education and technical assistance to existing and prospective property owners and to supporting real estate and banking interests can greatly reduce unwise decisions on shoreline structure siting and shore protection investments.	Could help inform real estate and banking interests as well as regulators and potential property owners.	Master Plans need to reflect wise decision making and then be widely distributed to owners, real estate agents and banking interests. They may need training to understand Master Plan and be involved in development so they have a stake.	Zoning ordinance often referred to by these interests but ordinance needs to be supported by Master Plan and have buy-in from these interests.	Setbacks probably already familiar to these interests but education and technical assistance needed for buy-in and increased capacity to apply setbacks.	Development interests may be opposed as long as there is a quick return potential that can be realized before property succumbs to hazard.	Probably will be the most help where repeated damage is likely or where there are parcel size restraints for moving structures.	Requires technical assistance and educated property owners or local officials to implement.
Objective 5: Speculate whether, over a period of time, the private sector could assume a principal responsibility and liability for ensuring the safe siting of structures in areas prone to flooding or erosion.	Access to this information could help the private sector in wise land use decision making.	Master Plan could serve as a guide to private sector.	Properly prepared zoning ordinance, based on Master Plan, could serve as guide to private sector.	Setbacks could be a tool used by the private sector as well as the public.	A policy of limiting public investment in hazard areas may hasten private involvement, hopefully in making wise decisions.	Would help reduce liability if long-term responsibility was assumed, and not short-term.	There is a recent (anecdotal, no data base) record of many private sector land acquisitions of sensitive and also hazard area acquisitions.

Table 7 (Continued)

Objectives	Shoreland regulations	Habitat regulations	Deed restrictions and real estate disclosures	Loans	Grants	Insurance programs	Tax incentives
Objective 1: Reduce damages to structures and property from erosion, flooding and extreme high and low water impacts	Probably has been instrumental in reducing losses.	Not the intent of the legislation, but may have small indirect benefit of loss reduction.	Not used sufficiently, so has not overcome draw to shoreline (and thus hazardous) locations.	Have not been applied to Lake Michigan but could help with moving structures, especially public facilities.	Could work if grants were made for local planning or hazard mitigation and if grants for infrastructure were eliminated in hazard areas.	Could be more effective.	Could help limit structural damage if local communities could (or believed they could) finance themselves without loss of revenues from properties in hazard areas.
Objective 2: Reduce loss of shoreline property and structure use from erosion, flooding and extreme high and low water impacts.	Probably has been instrumental in reducing losses.	Not the intent of the legislation, but may have small indirect benefit of loss reduction.	Not used sufficiently, so has not overcome draw to shoreline (and thus hazardous) locations.	Have not been applied to Lake Michigan but could help with moving structures, especially public facilities.	Could work if grants were made for local planning or hazard mitigation and if grants for infrastructure were eliminated in hazard areas.	Loss of land (erosion) or use of land (flooding) will likely occur regardless of institutional programs.	Loss of land (erosion) or use of land (flooding) will likely occur regardless of institutional programs.
Objective 3: Investigate whether some shoreline management approaches can be effectively, efficiently and fairly established and implemented by local units of government while others can best be established and/or administered at the state level.	Local governments often reluctant to impose, if regulations are too complicated or enforcement difficult. But would likely administer in least hazardous areas if state handled others.	Local governments often reluctant to impose. Best left to state.	Could be required locally if there is the political will.	Administration could be local but there is not enough resources at the local level to provide sufficient funds.	Administration could be local but there is not enough resources at the local level to provide sufficient funds.	Local involvement may be useful but scope of programs may require larger service area.	Could be effective if local community not so dependent on local financing of services, or if tax loss came from state, not local taxes.

Table 7 (Continued)

Objectives	Shoreland Regulations	Habitat Regulations	Deed Restrictions and Real Estate Disclosures	Loans	Grants	Insurance Programs	Tax Incentives
Objective 4: Investigate whether education and technical assistance to existing and prospective property owners and to supporting real estate and banking interests can greatly reduce unwise decisions on shoreline structure siting and shore protection investments.	Important as the uneducated make the unwise siting decisions. New information about shore processes emerging. Good time to be educating.	May have less impact where parcel size permits little choice in siting structures—they get first priority with property owners.	A useful tool for prospective property owners that has support of groups outside the real estate industry.	Loan programs may help provide education and technical assistance.	Grant programs may help provide education and technical assistance.	Insurance programs could be part of an education and technical assistance package, especially if there are strict mitigation requirements.	An education program that revealed the fiscal impacts of living in and providing services to hazard areas could be an informative educational tool.
Objective 5: Speculate whether, over a period of time, the private sector could assume a principal responsibility and liability for ensuring the safe siting of structures in areas prone to flooding or erosion.	Could work if there is a fair and strong mechanism to sanction those that failed to properly exercise their responsibility.	Enforcement particularly important here because irreparable harm possible.	A potentially informative tool if accepted by real estate interests and accuracy can be substantiated.	With clear standards, procedures and oversight for proper use, loan programs could be effective if administered by the private sector (as already done with many low income housing programs).	With clear standards, procedures and oversight for proper use, grant programs could be effective if administered by the private sector.	Insurance programs could be part of a package of tools used by the private sector.	Tax incentives could be part of a package of tools used by the private sector.